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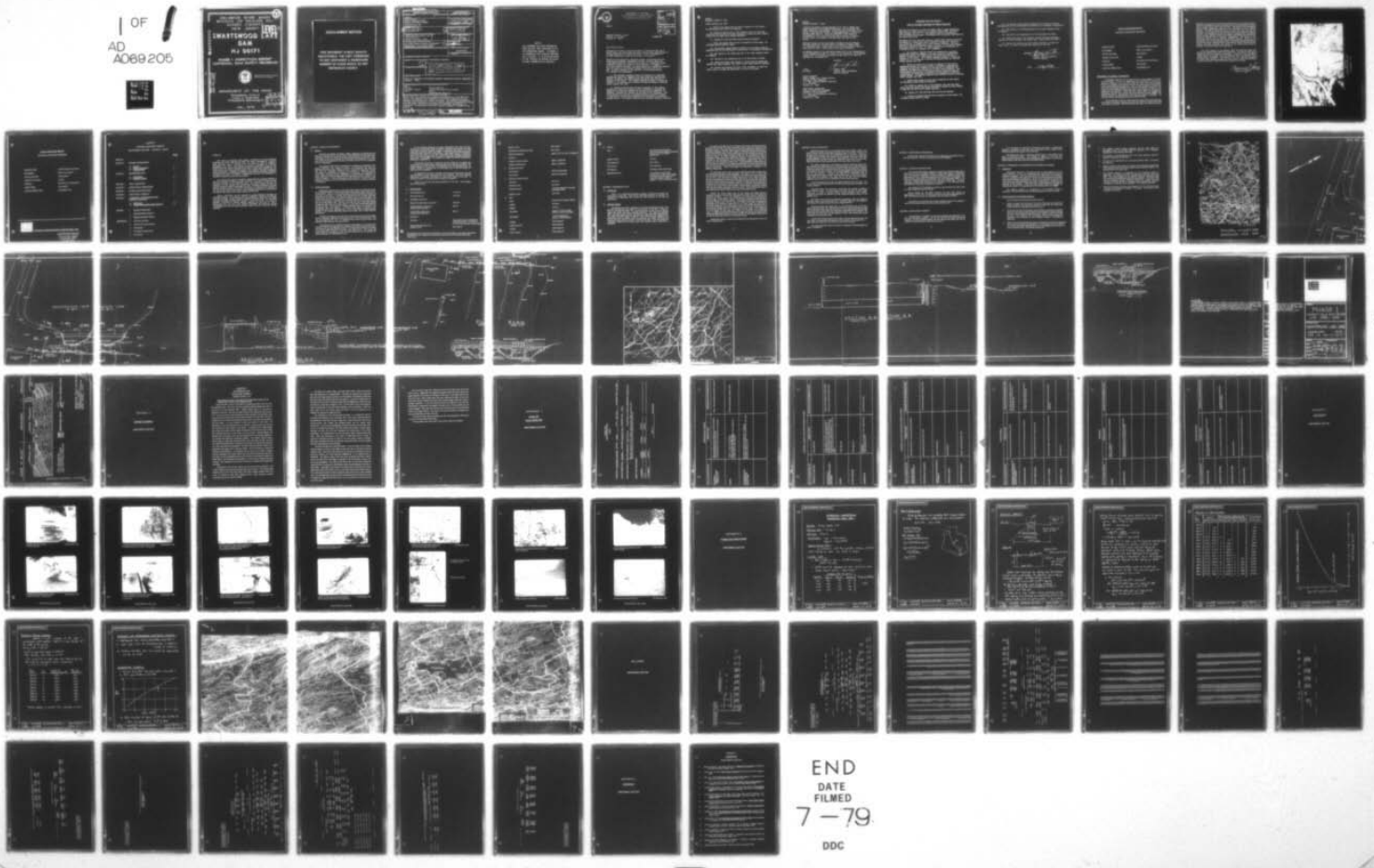

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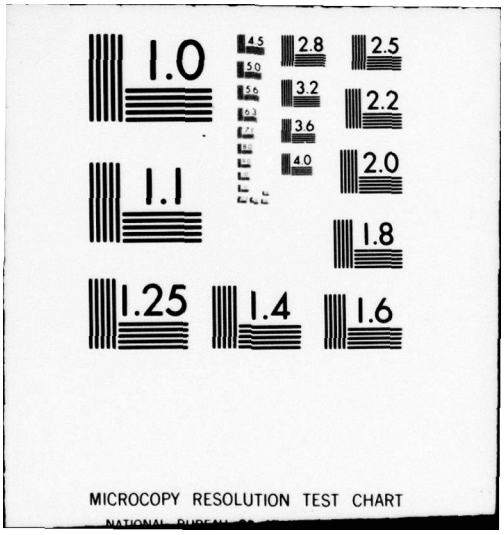
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DELAWARE RIVER BASIN
BRANCH OF PAULINS KILL
SUSSEX COUNTY
NEW JERSEY

LEVEL II

SWARTSWOOD LAKE DAM
NJ 00171

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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DEPARTMENT OF THE ARMY
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Philadelphia, Pennsylvania

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REPORT DOCUMENTATION PAGE

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1. REPORT NUMBER: NJ00171

2. GOVT ACCESSION NO.

3. RECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle): Phase I Inspection Report
National Dam Safety Program
Swartswood Lake Dam
Sussex County, N.J.

5. TYPE OF REPORT & PERIOD COVERED: (9) FINAL rept.

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s): (10) Dennis J. Leary P.E.

8. CONTRACT OR GRANT NUMBER(s): (15) DACW61-78-C-0124

9. PERFORMING ORGANIZATION NAME AND ADDRESS:
Langan Engineering Assoc. Inc.
970 Clifton Ave.
Clifton, New Jersey 07013

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: (12) 82p.

11. CONTROLLING OFFICE NAME AND ADDRESS: (11)
U.S. Army Engineer District, Philadelphia
Custom House, 2d & Chestnut Streets
Philadelphia, Pennsylvania 19106

12. REPORT DATE: May [illegible]79

13. NUMBER OF PAGES: 75

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)

15. SECURITY CLASS. (of this report): Unclassified

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

(6) National Dam Safety Program. Swartswood Lake Dam (NJ00171), Delaware River [illegible] Basin, Branch of Paulins Kill, Sussex County, New Jersey. Phase 1 Inspection Report.

17. DISTRIBUTION STATEMENT (of the abs[illegible])

18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dams
Spillway
Structural Analysis
Safety
Visual Inspection
National Dam Inspection Act Report
Safety
Swartswood Lake Dam, N.J.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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IN REPLY REFER TO

NAPEN-D

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, NJ 08621

15 MAY 1979

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Swartswood Lake Dam in Sussex County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Swartswood Lake Dam, initially listed as a high hazard potential structure but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in poor overall condition. The dam's spillway is considered inadequate since 17 percent of the Probable Maximum Flood would overtop the dam. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980.

b. Within six months from the date of approval of this report, engineering studies and analyses should be performed to determine the condition and structural stability of the dam and its foundation and abutments; including the spillway and low level outlet structure. This should include test borings to determine material properties relative to stability and seepage and installation of piezometers to facilitate seepage studies. Any remedial measures found necessary should be initiated

within calendar year 1980.

c. Within three months from the date of approval of this report, the following actions should be completed:

(1) Reline or replace the 3.5 foot diameter cast iron low level outlet pipe and relocate the intake structure or provide an inlet channel to make the low level outlet system functional.

(2) Remove all trees and brush from the dam and abutment.

d. Within six months from the date of approval of this report, the following actions should be taken:

(1) The spillway channel masonry sidewalls and the walls along the downstream face of the dam should be repaired and, if necessary, strengthened.

(2) The erosion at the downstream side of the right abutment should be repaired.

(3) The hole at the downstream toe of the dam should be filled.

(4) Debris and fallen trees should be cleared from the downstream channel and, where necessary, the eroded channel banks should be repaired.

(5) Operate the repaired low level outlet regularly, at least two times a year, to ensure the operational condition of the gate.

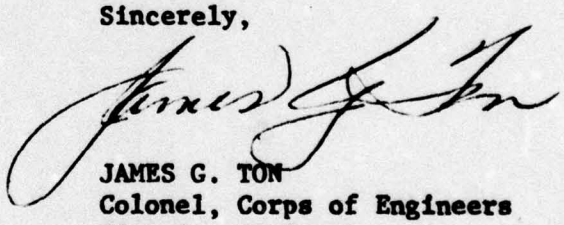
NAPEN-D
Honorable Brendan T. Byrne

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman James A. Courter of the Thirteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,



JAMES G. TON
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

Copies furnished:
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N. J. Dept. of Environmental Protection
P. O. Box CN029
Trenton, NJ 08625

John O'Dowd, Acting Chief
Bureau of Flood Plain Management
Division of Water Resources
N. J. Dept. of Environmental Protection
P. O. Box CN029
Trenton, NJ 08625

SWARTSWOOD LAKE DAM (NJ00171)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 12 and 20 December 1978 by Langan Engineering Associates Inc. under contract to the State of New Jersey. The State, under agreement with the U. S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Swartswood Lake Dam, initially listed as a high hazard potential structure but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in poor overall condition. The dam's spillway is considered inadequate since 17 percent of the Probable Maximum Flood would overtop the dam. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures, and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1980.

b. Within six months from the date of approval of this report, engineering studies and analyses should be performed to determine the condition and structural stability of the dam and its foundation and abutments; including the spillway and low level outlet structure. This should include test borings to determine material properties relative to stability and seepage and installation of piezometers to facilitate seepage studies. Any remedial measures found necessary should be initiated within calendar year 1980.

c. Within three months from the date of approval of this report, the following actions should be completed:

(1) Reline or replace the 3.5 foot diameter cast iron low level outlet pipe and relocate the intake structure or provide an inlet channel to make the low level outlet system functional.

(2) Remove all trees and brush from the dam and abutment.

d. Within six months from the date of approval of this report, the following actions should be taken:

(1) The spillway channel masonry sidewalls and the walls along the downstream face of the dam should be repaired and, if necessary, strengthened.

(2) The erosion at the downstream side of the right abutment should be repaired.

(3) The hole at the downstream toe of the dam should be filled.

(4) Debris and fallen trees should be cleared from the downstream channel and, where necessary, the eroded channel banks should be repaired.

(5) Operate the repaired low level outlet regularly, at least two times a year, to ensure the operational condition of the gate.

APPROVED: James G. Tom

JAMES G. TOM
Colonel, Corps of Engineers
District Engineer

DATE: 11 May 1979

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

NAME OF DAM:	SWARTSWOOD LAKE DAM
ID NUMBER:	FED Id. No. NJ00171
STATE LOCATED:	NEW JERSEY
COUNTY LOCATED:	SUSSEX
STREAM:	BRANCH OF PAULINS KILL
RIVER BASIN:	DELAWARE
DATE OF INSPECTION:	DECEMBER 1978

ASSESSMENT OF GENERAL CONDITIONS

Swartswood Lake Dam is 76 years old and in what appears to be poor overall condition. There is no engineering data concerning the dam and its foundation materials. The low level outlet has rusted and is not functional. There is a possibility that portions of the dam are natural ground with variable and uncertain engineering properties. There are trees growing on the dam with roots that have likely penetrated the entire cross section. Portions of the masonry has deteriorated at downstream face of both abutments and along the sidewalls of the spillway. Trees and other vegetal debris are clogging the downstream channel. The upstream side of the low level outlet is clogged. The spillway capacity as determined by CE Screening criteria is inadequate. We estimate the dam can adequately pass only 16% of the PMF.

We recommend to reline or replace the 3.5-ft-dia CI low level outlet pipe and relocate the intake structure or provide inlet channel to make the low level outlet system functional. This should be done very soon. The entire dam and its

foundation and abutments; including the spillway and low level outlet structure should be investigated by means of borings and tests, and piezometers should be used to measure water levels within the dam. The results of the investigation should provide engineering properties of the materials for use in stability analyses. Remove all trees and brush and their roots from the dam and abutment. It is recognized that this is likely to be not only a difficult procedure but that it may endanger the entire dam unless it is properly done. The spillway channel masonry sidewalls and the walls along the downstream face of the dam should be repaired and if necessary, strengthened. The erosion at the downstream side of the right abutment should be repaired. The hole at the downstream toe of the dam should be filled. The above recommended measures should be done soon. Debris and fallen trees should be cleared from downstream channel and where necessary, the erosion of the channel banks should be repaired. This should be done in the near future.

The actual capacity of the spillway should be determined using more precise and sophisticated methods and procedures. The need for and type of mitigating measures should be determined. Around the clock surveillance during periods of unusually heavy precipitation should be provided, and a warning system established. This should be done soon. Operate the repaired low level outlet regularly, at least two times a year, to ensure the operational condition of the gate. This should be done regularly in the future.

Dennis J. Leary

Dennis J. Leary, P. E.

OVERVIEW
SWARTSWOOD LAKE DAM

13 December 1978

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

NAME OF DAM:	SWARTSWOOD LAKE DAM
ID NUMBER:	FED Id. No. NJ00171
STATE LOCATED:	NEW JERSEY
COUNTY LOCATED:	SUSSEX
STREAM:	BRANCH OF PAULINS KILL
RIVER BASIN:	DELAWARE
DATE OF INSPECTION:	DECEMBER 1978

LANGAN ENGINEERING ASSOCIATES, INC.

Consulting Civil Engineers
990 CLIFTON AVENUE
CLIFTON, NEW JERSEY
201-472-9366

CONTENTS

NATIONAL DAM SAFETY REPORT

SWARTSWOOD LAKE DAM FED ID No. NJ00171

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

SECTION 1 PROJECT INFORMATION

1.1 General

Authority to perform the Phase I Safety Inspection of Swartswood Lake Dam was received from the State of New Jersey, Department of Environmental Protection, Division of Water Resources by letter dated 20 November 1978. This Authority was given pursuant to the National Dam Inspection Act, Public Law 92-367 and by agreement between the State and the US Army Engineers District, Philadelphia.

The purpose of the Phase I Investigation is to develop an assessment of the general conditions with respect to safety of Swartswood Lake Dam and appurtenances based upon available data and visual inspection, and determine any need for emergency measures and conclude if additional studies, investigations and analyses are necessary and warranted. The assessment is made using screening criteria established in Recommended Guidelines for Safety Inspection of Dams prepared by the Department of Army, Office of the Chief of Engineers. It is not the purpose of the inspection to imply that a dam meeting or failing to meet the screening criteria, is per se, certainly adequate or inadequate.

1.2 Project Description

Swartswood Lake Dam is a 76-year-old, 100-ft-long, 16-ft-high earth dam. The downstream slope is vertical with stone facing and the width of the crest is at least 20 ft. There is a rock filled timber-crib overfall spillway upstream of the center of the dam. It is about 50-ft-long and its crest is about three feet below the top of the dam. The overfall is about 12-ft to a concrete apron that extends from the toe of the spillway to the downstream face of the dam. The crest of the spillway is reported to be 9-ft-wide with 6-ft of concrete slab on the top of the timber crib. There is 3.5-ft-dia low level outlet pipe passing through the right side of the dam. There is a 15-ft-wide wood bridge along the top of the dam. It lies over the spillway discharge apron and is about 15-ft downstream from the spillway. A historic mill house is located at the downstream side of the right abutment. The old mill brook runs approximately parallel to the spillway discharge channel and merges with it about 400 feet downstream.

The dam is located at the south end of Swartswood Lake east of W. Shore Drive in Stillwater Township, Sussex County, N.J. It is at north latitude 41° 3.6' and west longitude 74° 51.2'. A regional vicinity map is given in Fig 1 and essential project features are given in Fig 2.

Swartswood Dam is classified as being "Intermediate" on the basis of its maximum reservoir storage volume of 5860 acre-feet which is more than 1,000 - acre feet, but less than 50,000-acre feet. It is classified as "Small" on the basis of its total height of about 16 ft which is less than 40 feet. The overall size classification is the larger of these two determinations, and accordingly the dam is classified as "Intermediate" in size.

In the National Inventory of Dams, Swartswood Lake Dam has been classified as having "High Hazard Potential" on the basis that failure of the dam would cause excessive property damage to residences downstream, and could potentially cause more than a few deaths. Visual inspection of the downstream area shows that breach of the dam would cause little damage to residences which are located on high ground but could be hazardous to people utilizing low lying roads. Accordingly, it is proposed to change the Hazard Classification Potential to "Significant".

Swartswood Lake Dam is owned by the N.J. DEP Div. of Forests and Parks, Labor and Industry Bldg., Room 806, Box 1420, Trenton, N.J. 08625. The original purpose of the dam was for the operation of a now abandoned mill. Its present purpose is impoundment of Swartswood Lake so that its beauty and water level are maintained.

No essential information is available concerning the design of the dam and records indicate it was constructed by C.H. Crisman. No other essential information is available concerning the construction history of the dam. A historical summary of the dam and mill is given in Appendix 1.

There are no formal operating procedures for the dam. Park Rangers patrol the dam daily.

1.3 Pertinent Data

a.	The Drainage area is	17.2 sq mi
	The Lake Area is:	516 acres
b.	Discharge at Dam Site	
	Maximum known flood at dam site:	Unknown
	Ungated spillway capacity at maximum pool elevation:	866 cfs
	Total spillway capacity at maximum pool elevation:	866 cfs
c.	Elevation *	
	Top dam:	Approx. Elev. 485 at embankment and bridge section. Low point at El. 484.17 downstream stone facing.
	Normal pool (assumed to be spillway crest):	Elev. 481.43

* All elevations are referenced to a benchmark elevation of 484.47 at the right embankment established by N.J. Geodetic Control Survey, Dept of Conservation BM Station 202. (See Fig 2).

	Spillway crest:	Elev. 481.43
	Streambed at centerline of dam:	Elev. 469.±
	Maximum tailwater:	Approx. 471.5 at time of inspection
d.	Reservoir	
	Length of maximum pool:	Approx. 12050 feet
	Length of normal pool:	Approx. 12000 feet
e.	Storage (acre-feet)	
	Normal pool:	4000 AF (estimated)
	Top of dam:	5860 AF (estimated)
f.	Reservoir Surface (acres)	
	Top dam:	524 Acres
	Maximum pool:	524 Acres
	Recreation pool:	516 Acres (assumed to be same as spillway crest)
	Spillway crest:	516 Acres
g.	Dam	
	Type:	Earth fill with masonry facing
	Length:	100 feet ±
	Height:	16 feet ±
	Top width:	Approx. 15 feet at bridge 20 feet or more at two ends
	Side slopes:	Vertical downstream; approx. 1V:10H upstream
	Zoning:	None observed
	Impervious core:	None observed
	Cutoff:	None observed
	Grout curtain:	None observed

h.	Spillway	
	Type:	Overfall broad-crested weir with crest inclined slightly downward. Reported to be rock-filled timber-crib.
	Length of Weir:	50 feet ±
	Crest elevation:	Elev. 481.43
	U/S channel:	None observed
	D/S channel:	Discharge under wood bridge
i.	Regulating Outlets	3.5-ft-dia low level CI pipe through dam at right side of bridge. Sluice gate does not operate and upstream entrance to pipe is plugged. Access is from top of dam.

SECTION 2 ENGINEERING DATA

2.1 Introduction

There is no essential information available concerning the design and construction of the dam. There are no operating procedures or records. An evaluation of engineering data cannot be made because of the lack of information.

2.2 Regional Geology

Swartswood Lake Dam is located in the Valley and Ridge Province. This province encompasses one-twelfth of the land area of the state - chiefly in Warren and Sussex Counties. It is characterized by a series of nearly parallel ridges and valleys that trend northeast-southwest. The ridges are underlain with northwest dipping Silurian and Devonian sandstones and conglomerates. The upper Delaware Valley is underlain with weak Devonian limestones and shales while the Kittatinny Valley is underlain with folded Cambrian and Ordovician limestones and shales. Kittatinny Mountain is the most prominent topographic feature and its nearly even crest averages 1600 to 1800 feet in elevation.

The Valley and Ridge Province is divided into western, middle, and eastern sections that include the Upper Delaware Valley, Kittatinny Mountain, and Kittatinny Valley. The Upper Delaware Valley encompasses the region west of Kittatinny Mountain that has been eroded in Devonian limestones and shales. Kittatinny Mountain makes up the middle section of the Province and forms the eastern border of the Upper Delaware Valley and the northwestern border of Kittatinny Valley. The ridge is underlain with the very resistant lower Silurian Shawangunk conglomerate and High Falls sandstone. The northeastern side is bordered by the escarpments of the Shawangunk conglomerate, which rise steeply from the Kittatinny Valley floor. The Shawangunk conglomerate has been extensively broken up into large rock fragments by mechanical weathering and frost action and forms mass wasted talus slopes along the ramparts of the eastern escarpment. These talus slopes are extensively developed in the Delaware Water Gap.

The Kittatinny Valley area is a broad northeast-southwest lowland where the Harrisburg Peneplain is well developed. The valley is 10 to 13 miles wide and lies between the New Jersey Highlands on the east and Kittatinny Mountain on the west. The Wisconsin ice sheet covered all of the Valley and Ridge Province and deposited a terminal moraine south of the province near Belvidere. Much of the land surface north of the terminal moraine consists of a thin sheet of glacial till and ice-scoured bedrock surfaces. In addition, fluvial deposits of stratified drift consisting of eskers, kames, kame terraces, and deltas mantle many of the areas of the valley bottoms. Discontinuous recessional moraines were deposited during stillstands in the ice retreat. These moraines now form a discontinuous low band of hills across nearly all of Sussex County.

Glacial till covers large areas of the Valley and Ridge Province. Generally the till is extremely thin and sometimes present only in patches or as scattered boulders. It is best developed on broad summits, interstream surfaces, and in low passes or cols, and is thinnest or absent on steep slopes, on narrow ridges, and in narrow valleys. The greatest thickness of the till in the Kittatinny Valley is over 100 feet just on the edge of the valley at Ogdensburg. Estimates of the thickness range from 8 to 10 feet along the west slope of Kittatinny Mountain; 2 to 3 feet along the crest of Kittatinny Mountain; 5 to 10 feet on the limestone belts of Kittatinny Valley; 8 to 12 feet on the shale belts of Kittatinny Valley; and from 5 to 20 feet in Vernon Valley. The composition of till is largely of local origin and reflects the character of the underlying rock. It is generally compact because of the high clay content derived from the weathered shales and has many resistant boulders of Shawangunk conglomerate as well as erratics derived from more distant sources.

Swartswood Lake is a basin lake produced by the obstruction of the river valley by glacial drift.

SECTION 3 VISUAL INSPECTION

Swartswood Lake Dam is an earth-fill dam with masonry facing. The broad crested overfall type spillway located at about the center of the dam is set back about 20 feet from the longitudinal axis of the dam. Water was flowing over the spillway with about 3-inch head at the time of our inspection. A clear inspection of the weir surface was not possible. However, at the right spillway/abutment junction, water was observed to flow over the weir at an angle, possibly due to the original design of the west masonry side wall.

The general alignment of the masonry structure appeared satisfactory. Some mortar cracks were observed on the downstream face. Loose stones were observed on both ends of the structure where it joins the abutments. Masonry at the downstream face of the left end of the dam appears to have been stacked up without any mortar or cement. No noticable seepage was observed from any part of the structure. Erosion was observed at downstream side of structure/abutment junction near the north-east corner of the old mill house. Large trees are growing at the right side of the dam near the spillway suggesting that portions of the embankment could be natural ground.

A 3.5-ft-dia pipe exists under the right abutment side of the dam. The area in front of the intake structure is filled and the pipe does not appear to be in use at present.

Scattered homes and recreation communities are located at different areas around the lake. The side slopes vary from very flat to fairly steep. There are no signs of unstable slopes except localized minor erosion. Considerable amounts of sediment has been deposited adjacent and up to the spillway crest.

No homes were observed immediately downstream until the Village of Stillwater which is about 2½ miles away. Scattered homes are also located in the vicinity of the dam area but they are at high elevations.

Numerous leaves and debris exist on the downstream side of the dam. Fallen trees and debris have collected and formed a natural obstruction across the channel about 100 to 300 feet downstream. Occasional fallen trees partially lying across the channel were also observed between these two locations. The toe of the left bank near the dam appears to have been washed and eroded, exposing the roots of some trees.

The old mill brook is located at the right of the downstream channel. The mill brook runs approximately parallel to the channel and merges with it about 400 feet downstream. No flow was observed in the brook.

The visual inspection check list is given in Appendix 2 and photographs are given in Appenidx 3.

SECTION 4 OPERATIONAL PROCEDURES

We have been informed that there are no operational procedures for the dam and facilities. The dam is patrolled daily by Park Rangers.

SECTION 5 HYDRAULIC/HYDROLOGIC

The hydraulic/hydrologic evaluation is based on a Spillway design Flood (SDF) equal to the full Probable Maximum Flood (PMF) chosen in accordance with the evaluation guidelines for dams classified as Significant Hazard and Intermediate in size. Hydrologic design data for this dam is not available. The PMF has been determined by developing a synthetic hydrograph based on the maximum probable precipitation of 22 inches (200 square mile - 24 hour). Hydrologic computations are presented in Appendix 4. The PMF peak inflow determined for the subject watershed is 14,755 cfs.

The capacity of the spillway at maximum pool elevation (El. 485) is 866 cfs which is significantly less than SDF.

Flood routing for the PMF indicates the dam will overtop by approximately 7.5 ft. For 1/2 PMF the same will overtop by approximately 3.7 feet. We estimate the dam can adequately pass only 16% of the PMF.

Drawdown of the reservoir has not been evaluated because the regulatory outlet is not operable when lake level is below spillway crest.

SECTION 6 STRUCTURAL STABILITY

No information is available concerning the engineering properties of the dam and foundation materials. We are not aware of any post construction changes or of any operating records. The fact the dam has existed for over 76 years is no indication that it will continue to do so.

It is our opinion the stability of Swartswood Lake Dam is marginal and should be considered to have less than conventional safety margins unless additional engineering analysis proves otherwise.

Swartswood Lake Dam is located in Seismic Zone 1 of the Seismic Zone Map of Contiguous States. The degree of stability of the dam and appurtenances is assumed to be less than adequate with respect to conventional safety margins under both static and earthquake loading.

SECTION 7 ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Assessment

Swartswood Lake Dam is 76 years old and in what appears to be poor overall condition. There is no engineering data concerning the dam and its foundation materials. The low level outlet has rusted and is not functional. There is a possibility that portions of the dam are natural ground with variable and uncertain engineering properties. There are trees growing on the dam with roots that have likely penetrated the entire cross section. Portions of the masonry has deteriorated at downstream face of both abutments and along the sidewalls of the spillway. Trees and other vegetal debris are clogging the downstream channel. The upstream side of the low level outlet is clogged.

The spillway capacity as determined by CE Screening criteria is inadequate. We estimate the dam can adequately pass only 16% of the PMF.

7.2 Recommendations and Remedial Measures

We recommend the following remedial measures:

1. Reline or replace the 3.5-ft-dia CI low level outlet pipe and relocate the intake structure or provide inlet channel to make the low level outlet system functional. This should be done very soon.

2. The entire dam and its foundation and abutments; including the spillway and low level outlet structure should be investigated by means of borings and tests, and piezometers should be used to measure water levels within the dam. The results of the investigation should provide engineering properties of the materials for use in stability analyses. This should be done soon.

3. Remove all trees and brush and if deemed necessary from further investigation, their roots from the dam and abutment. It is recognized that this is likely to be not only a difficult procedure but that it may endanger the entire dam unless it is properly done. This should be done soon.

4. The spillway channel masonry sidewalls and the walls along the downstream face of the dam should be repaired and if necessary strengthened. This should be done soon.

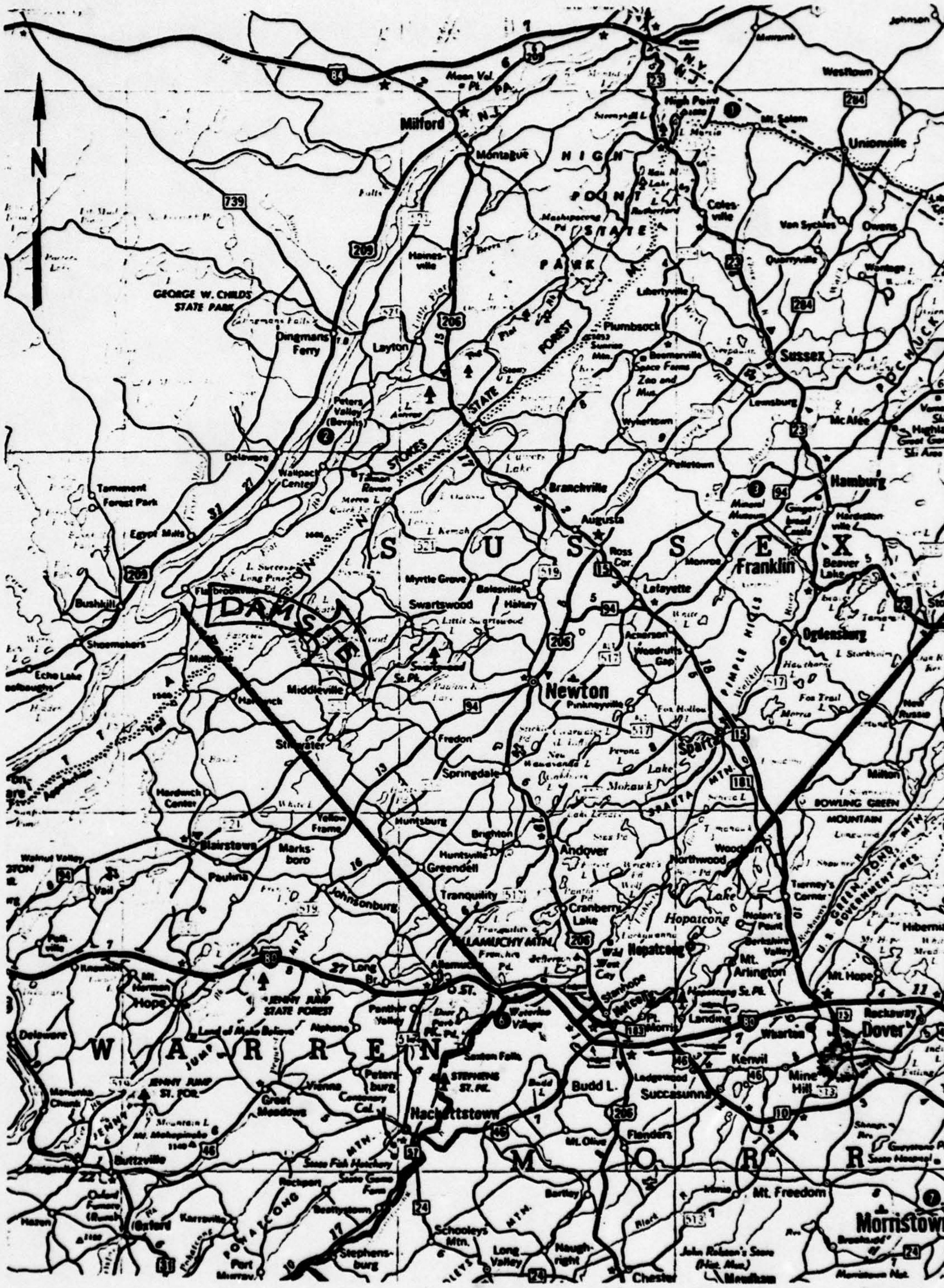
5. The erosion at the downstream side of the right abutment should be repaired. This should be done soon.

6. The hole at the downstream toe of the dam should be filled. This should be done soon.

7. Debris and fallen trees should be cleared from downstream channel and where necessary the erosion of the channel banks should be repaired. This should be done in the near future.

8. The spillway capacity as determined by CE Screening criteria is inadequate. We estimate the dam can adequately pass only 16% of the PMF. The actual capacity of the spillway should be determined using more precise and sophisticated methods and procedures. The need for and type of mitigating measures should be determined. Around the clock surveillance during periods of unusually heavy precipitation should be provided, and a warning system established. This should be done soon.

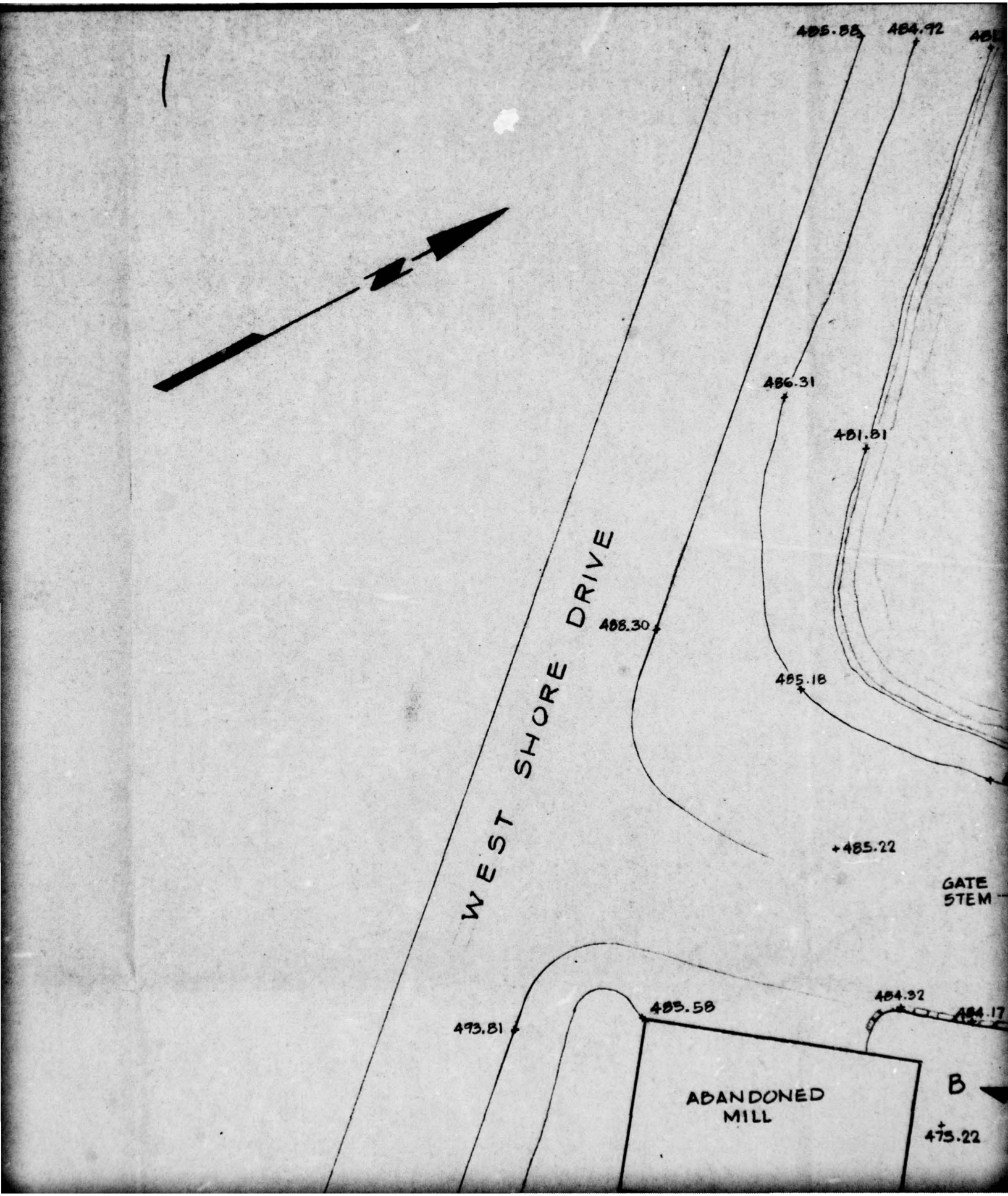
9. Operate the repaired low level outlet regularly, at least two times a year, to ensure the operational condition of the gate. This should be done regularly in the future.

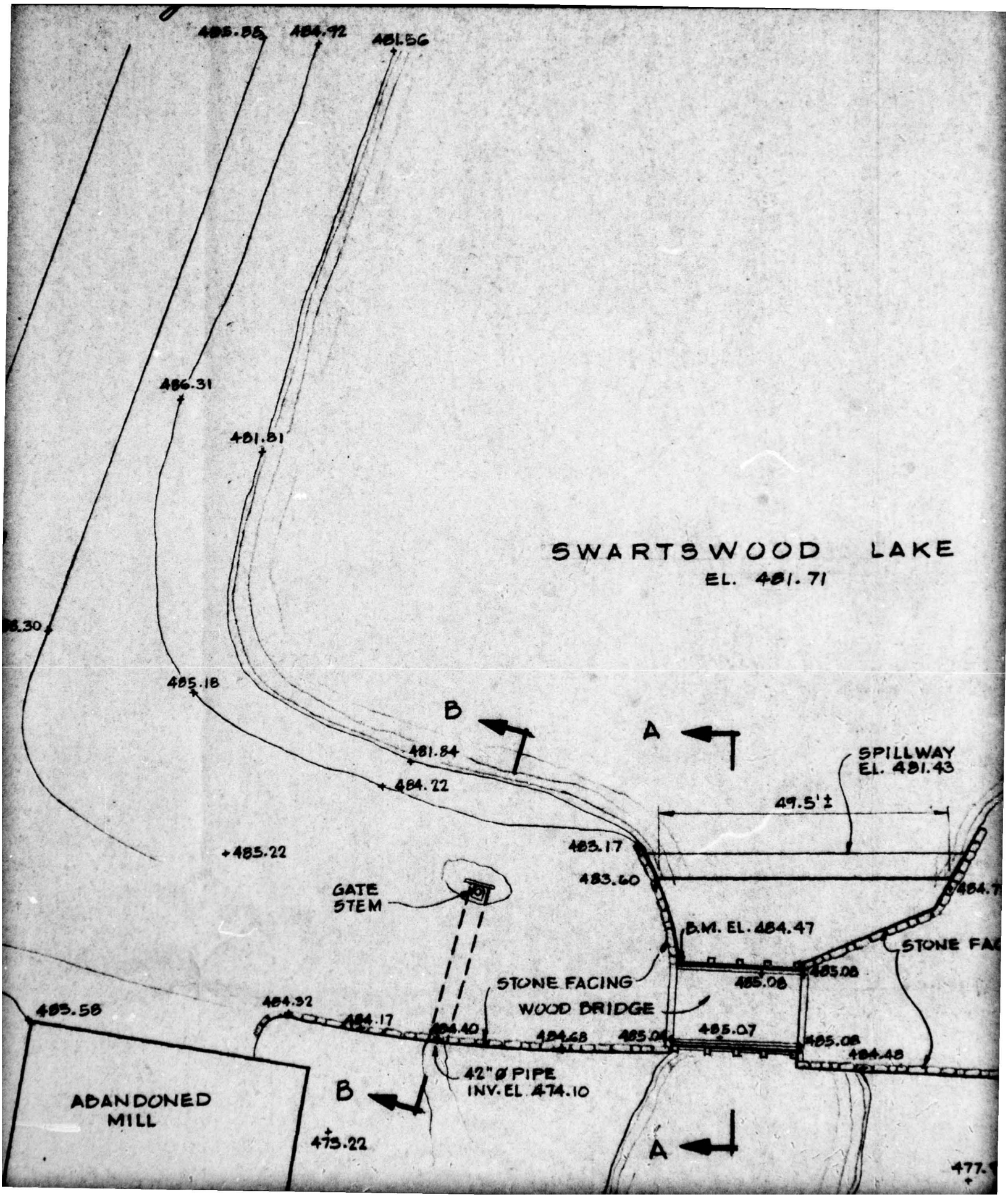


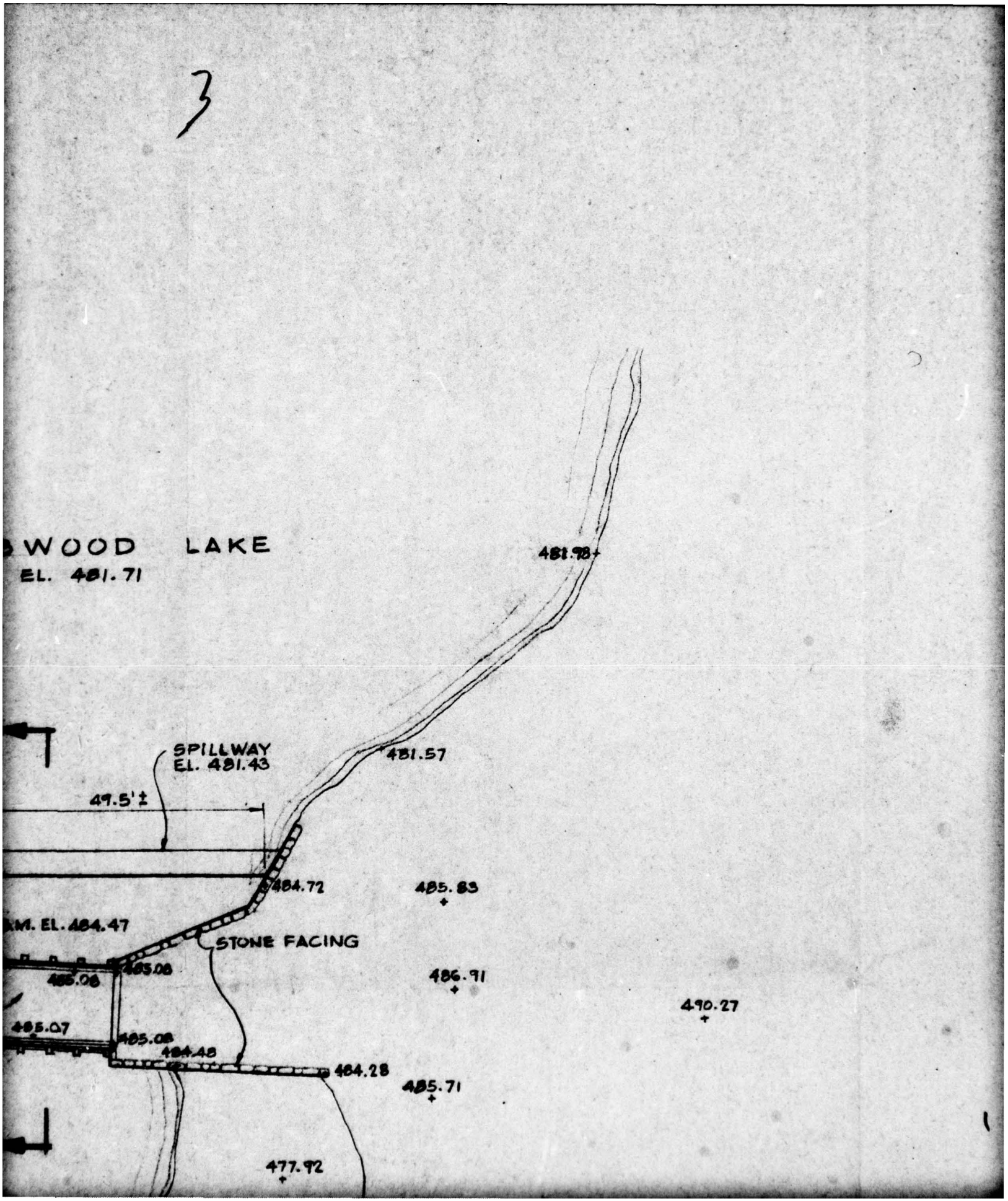
1in. ≃ 5.2mi

REGIONAL VICINITY MAP
SWARTSWOOD LAKE DAM

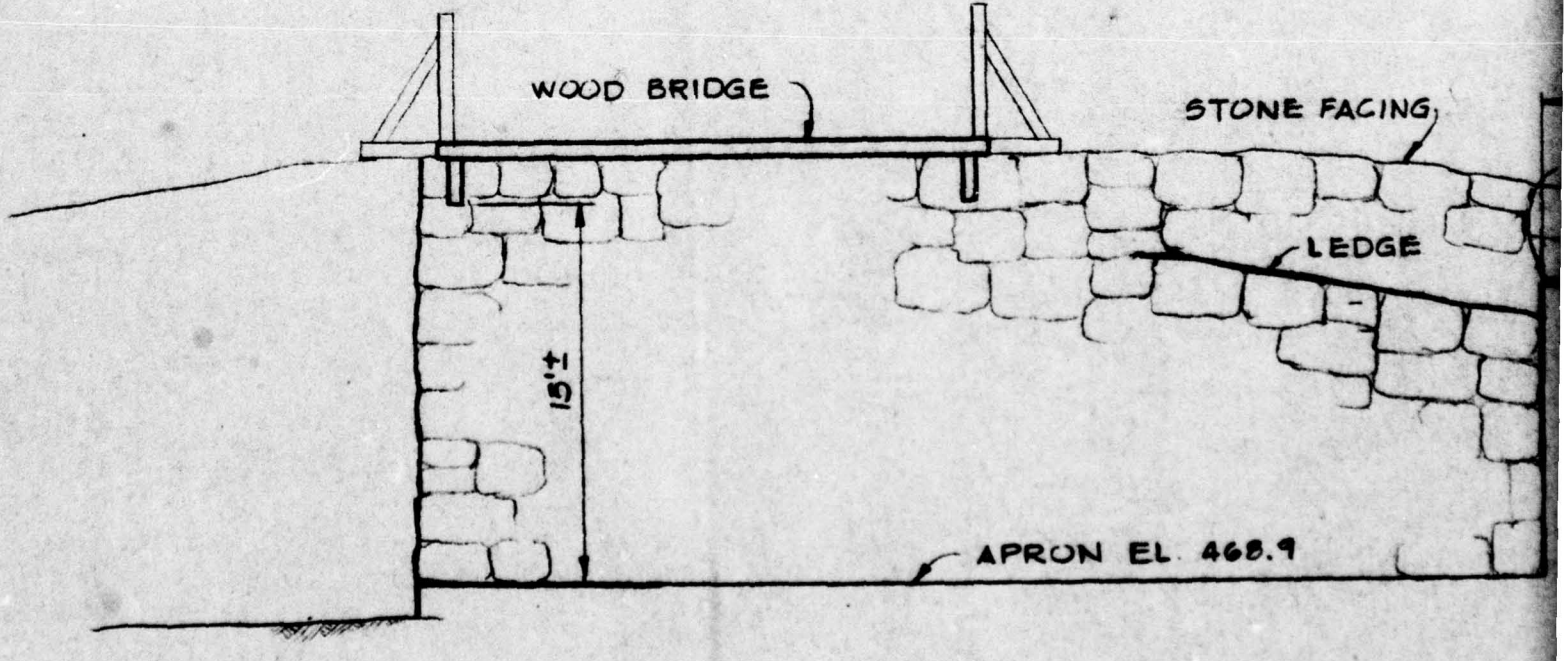
Fig. 1


485.88
484.92
486.31
481.81
488.30
485.18
WEST SHORE DRIVE
+485.22
GATE
STEM
484.32
485.58
484.17
493.81
ABANDONED
MILL
B
475.22


485.88
484.92
481.56
486.31
481.81
SWARTSWOOD LAKE
EL. 481.71
485.18
B
A
481.84
484.22
SPILLWAY
EL. 481.43
49.5'±
485.22
483.17
483.60
GATE
STEM
B.M. EL. 484.47
STONE FACING
WOOD BRIDGE
485.08
485.08
485.58
484.92
484.17
484.40
484.68
485.04
485.07
485.08
484.48
42" Ø PIPE
INV. EL. 474.10
B
ABANDONED
MILL
475.22
A


3
WOOD LAKE
EL. 481.71
481.78
SPILLWAY
EL. 481.43
481.57
49.5'±
484.72
485.83
M. EL. 484.47
STONE FACING
485.08
485.08
486.91
490.27
485.07
485.08
484.48
484.28
485.71
477.92

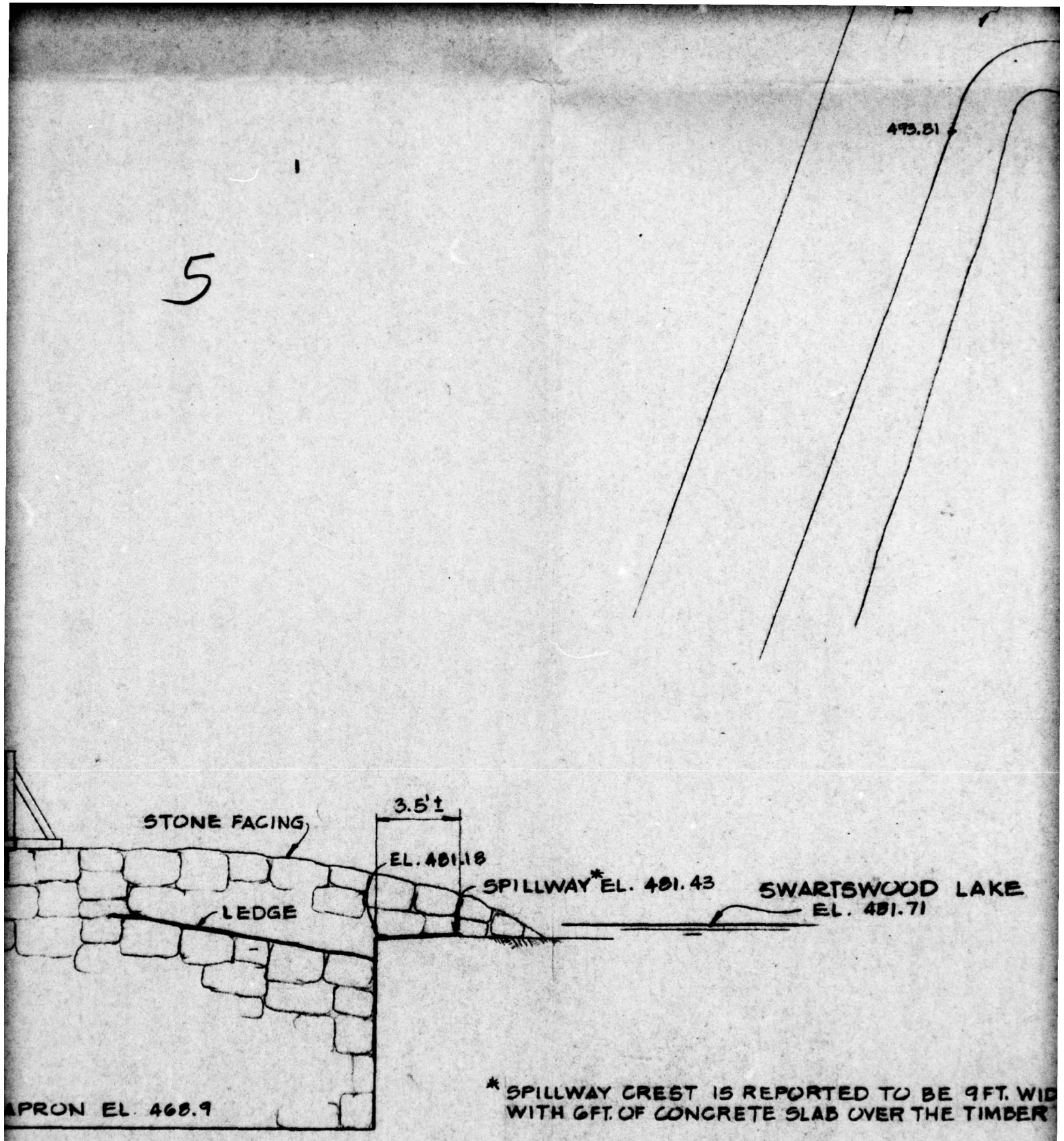
4



SECTION A-A

SCALE: 1"= 5'

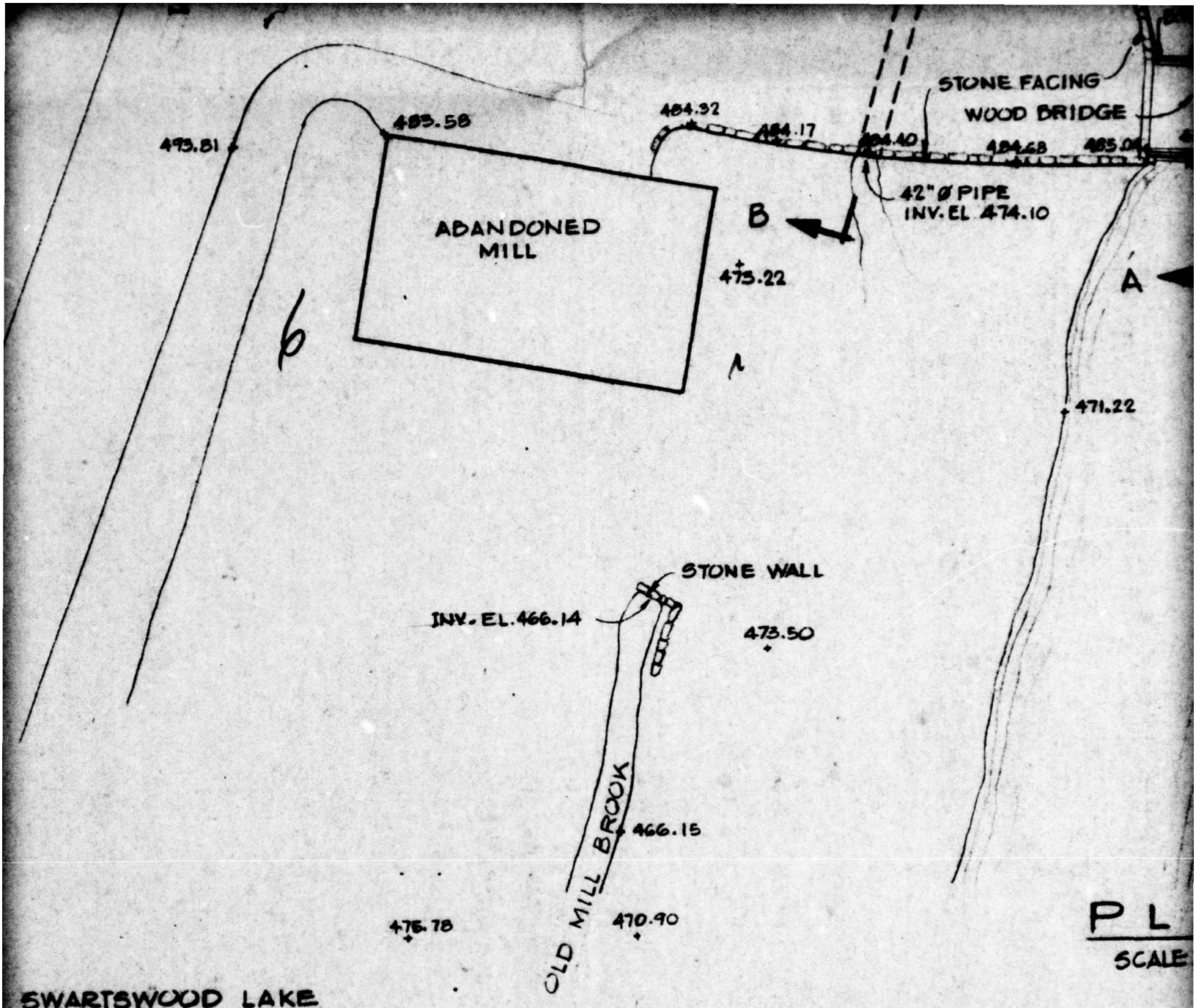
5



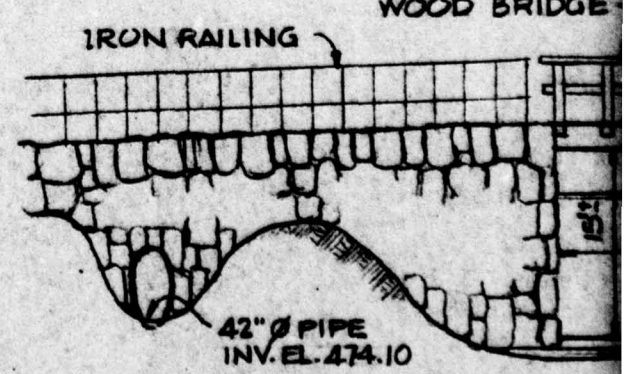
* SPILLWAY CREST IS REPORTED TO BE 9 FT. WID
WITH 6FT. OF CONCRETE SLAB OVER THE TIMBER

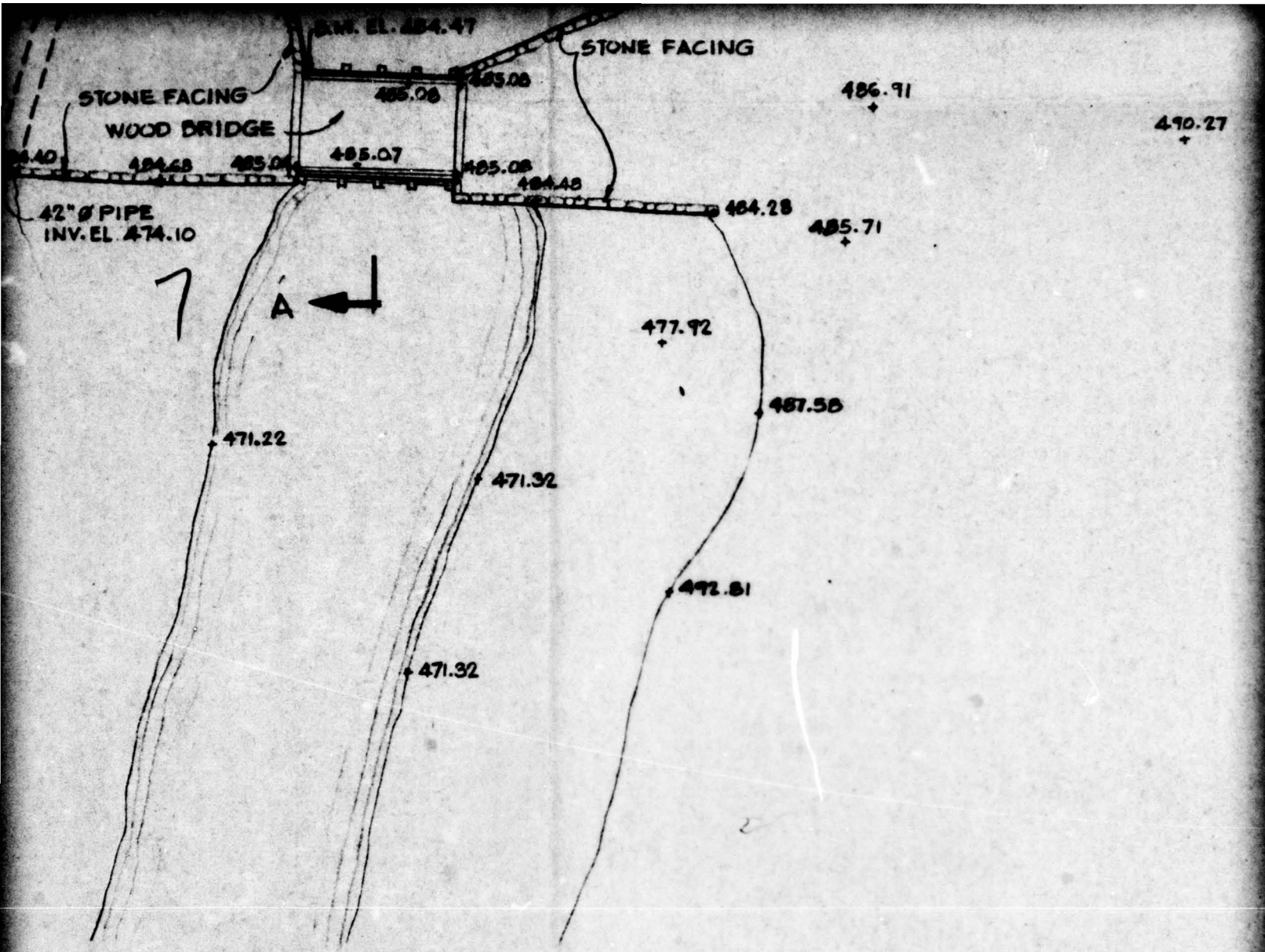
ON A-A

: 1"= 5'



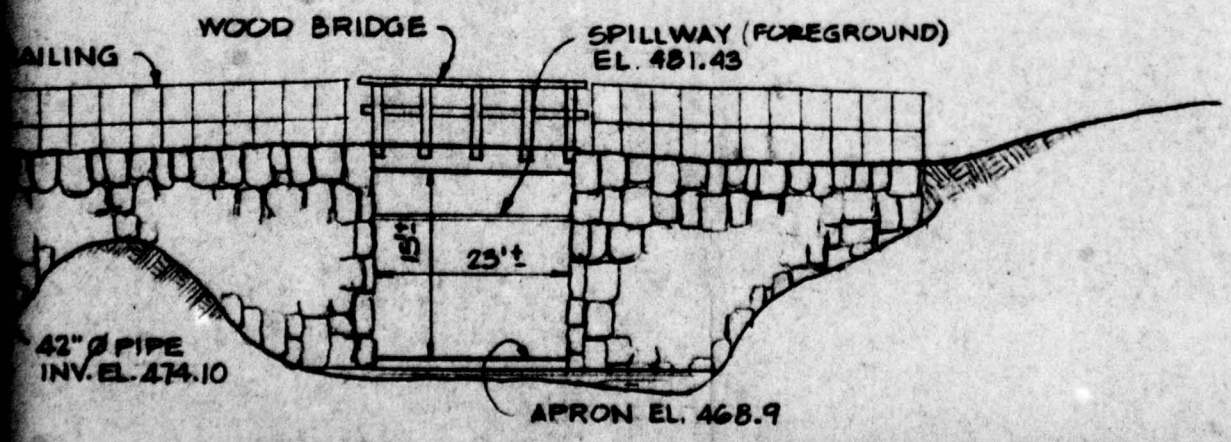
REPORTED TO BE 9 FT. WIDE
TE SLAB OVER THE TIMBER CRIB.

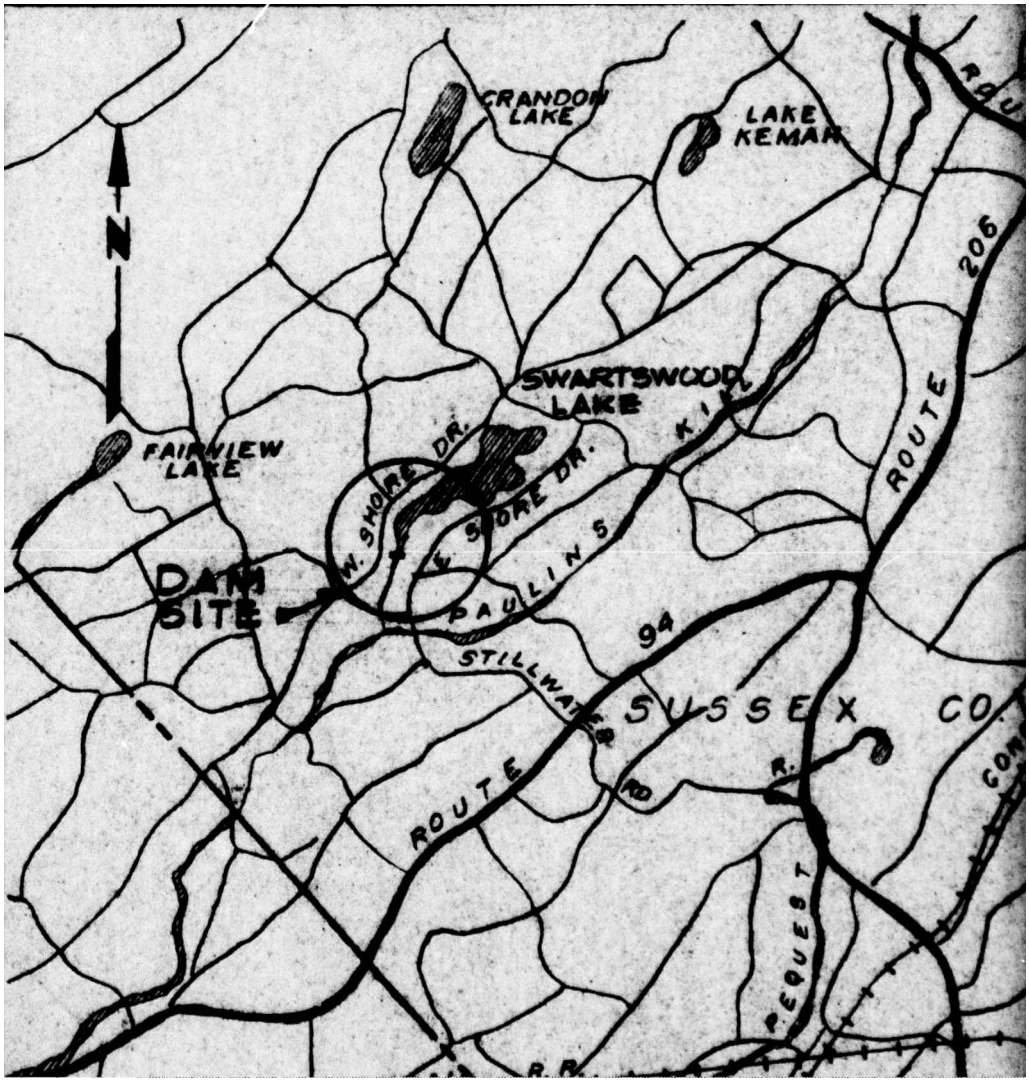




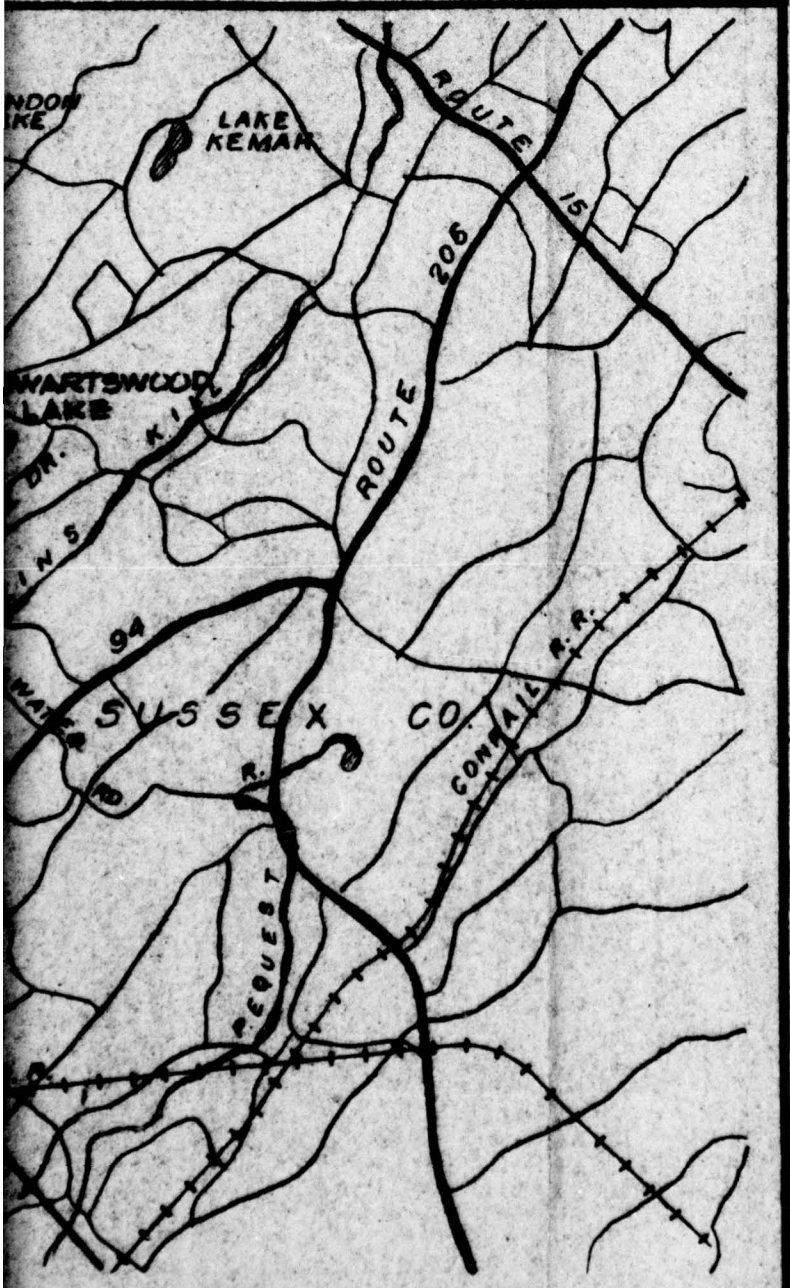
PLAN

SCALE: 1" = 20'




CRANDON LAKE
LAKE KEMAH
N
SWARTSWOOD LAKE
FAIRVIEW LAKE
W. SHORE DR.
E. SHORE DR.
DAM SITE
PAULINS
STILLWATER
ROUTE 94
ROUTE 206
SUSSEX CO.
PEQUEST
RD
R.

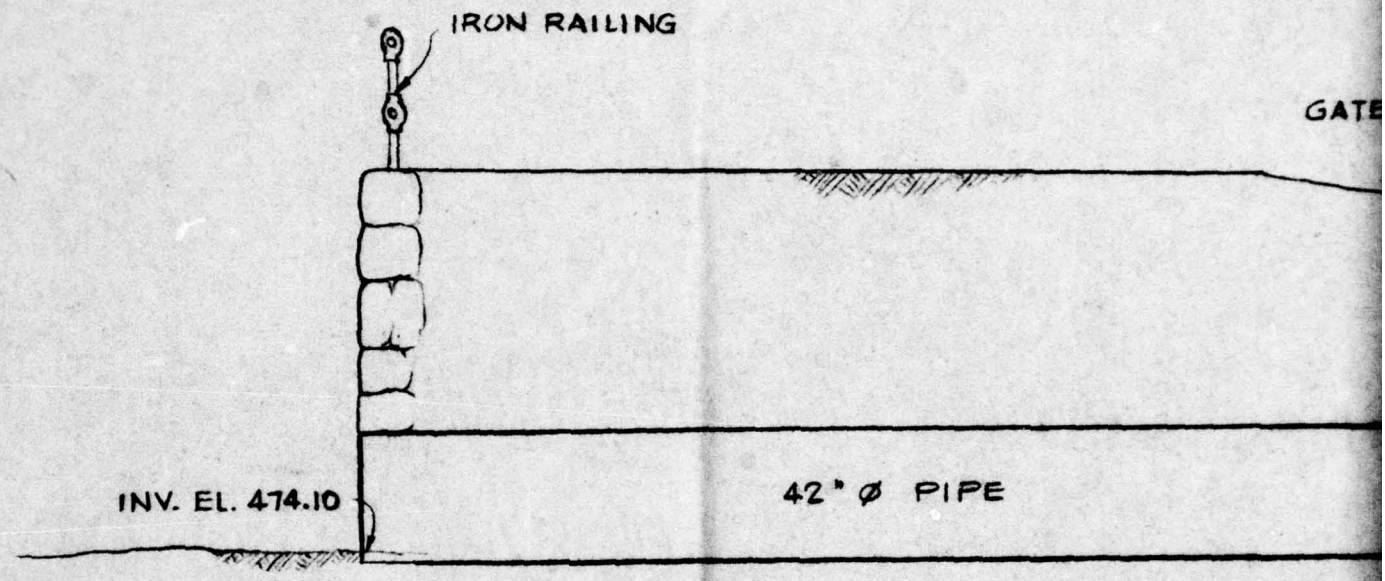
9



KEY PLAN

DATE	DESCRIPTION	NO.
REVISIONS		

10

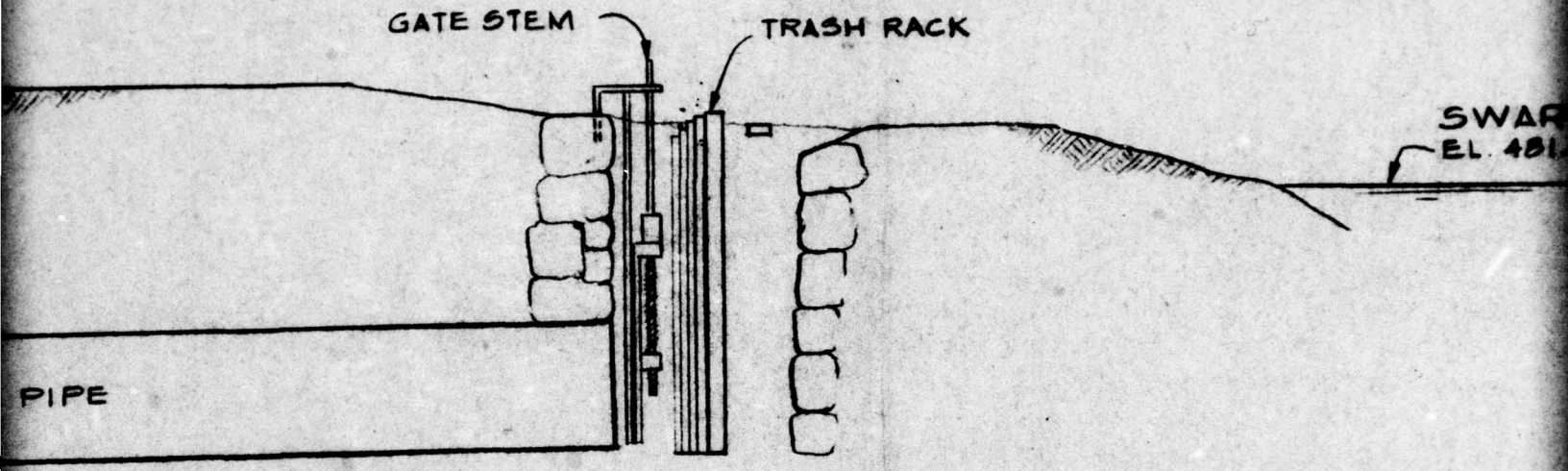


SECTION B-B

SCALE: 1" = 5'

11

NOTE: GATE AND TRASH RACK DO NOT APPEAR IN

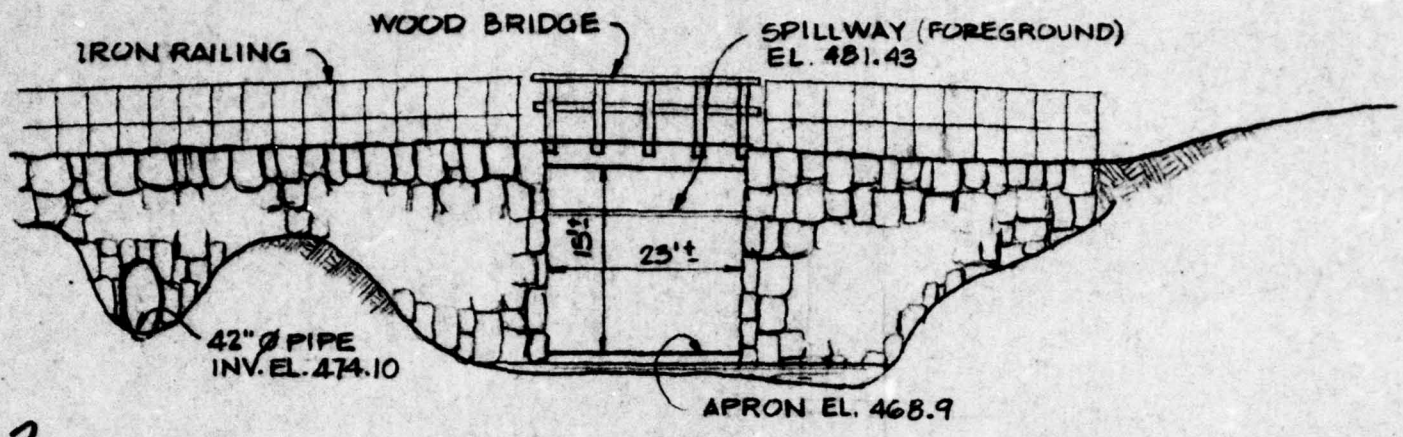


CTION B-B

CALE: 1" = 5'

12

TRASH RACK DO NOT APPEAR IN USE.



13

PROFILE (DOWNSTREAM)

SCALE: HORIZ: 1" = 20'
VERT: 1" = 10'

14

NOTE:

THE ELEVATIONS SHOWN WERE OBTAINED USING A SURVEYOR'S TRANSIT AND LEVEL AND A BENCHMARK ELEVATION OF 487.47 THAT WAS INDICATED ON THE SOUTHWEST CORNER OF THE WOOD BRIDGE AT THE SITE. THESE ELEVATIONS ARE APPROXIMATE. INFORMATION SHOWN BELOW GROUND SURFACE AND WATER LEVEL HAVE NOT BEEN CONFIRMED.

NED USING A SURVEYOR'S
EVATION OF 487.47 THAT
R OF THE WOOD BRIDGE
APPROXIMATE.
FACE AND WATER LEVEL

15

PROJECT

PHASE I

INSPECTION & EVALUATION
OF
NEW JERSEY DAMS

DRAWING TITLE

SWARTSWOOD LAKE DAM

FEBRUARY 1979
FED. I.D. NO. NJ00171

JOB NO. J-785B	DRAWING NO. FIG. 2
DATE 26, FEB 1979	
SCALE AS NOTED	
DRN. BY J. R.	
CHKD. BY D. J. L.	

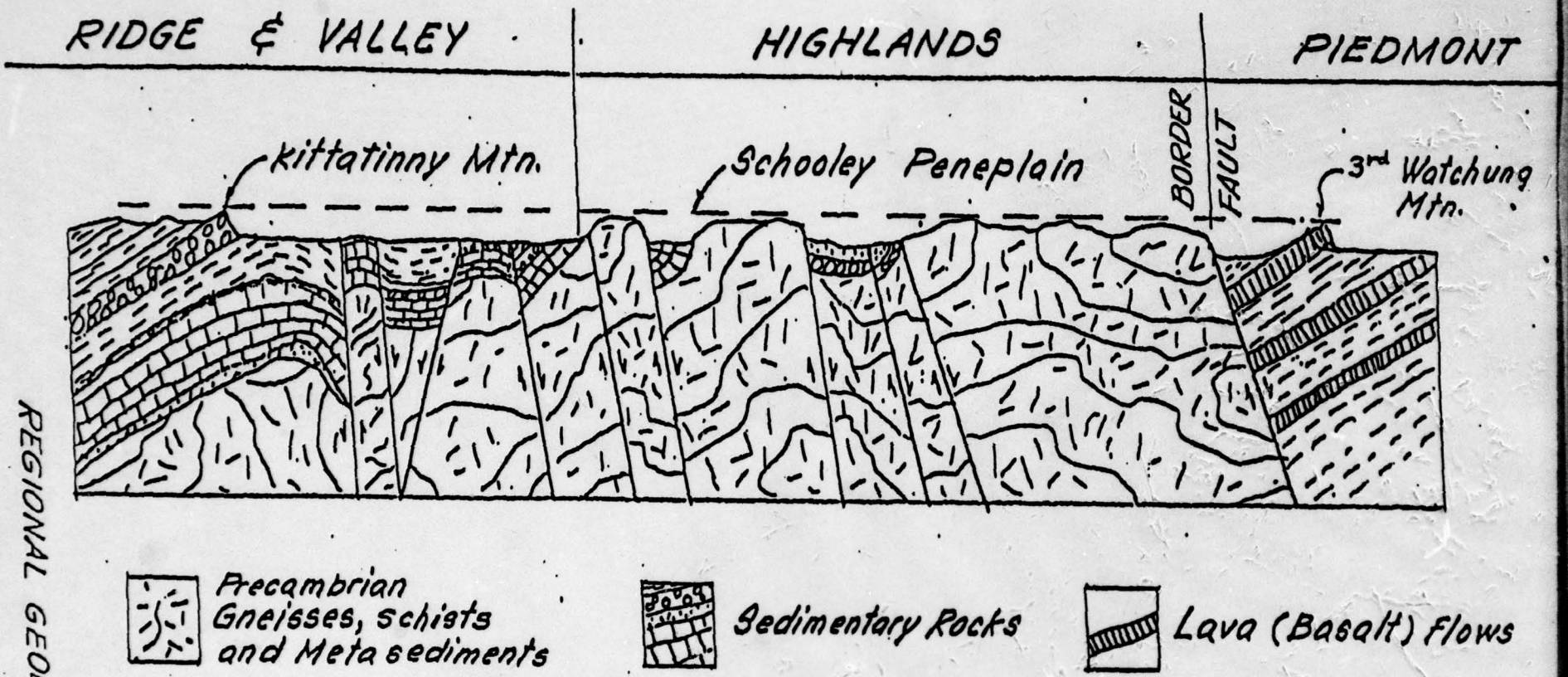


Fig. 3 - Schematic Cross-section of Ridge & Valley Physiographic Province (After Wolfe; 1977)

APPENDIX 1

HISTORICAL SUMMARY

SWARTSWOOD LAKE DAM

KEENS MILL
SWARTSWOOD LAKE
STILLWATER TOWNSHIP
SUSSEX COUNTY, N.J.

(This historic summary is extracted from informations posted on the bulletin board in front of the abandoned mill)

There has been a mill at the outlet to Swartswood Lake ever since the Revolutionary War. The first mill was erected by Charles Rhodes just prior to the end of the Revolutionary War. Charles Rhodes lived in a log cabin in Stillwater Township. He came to Sussex County from Monmouth County about 1779. He was forced to leave Monmouth County because of the constant raids by the British and Tories that occurred there between 1778 and 1782. He built a wooden mill at the outlet of Swartswood Lake where it empties into the present day mill brook. It is not certain if a dam was erected at this time. No description of the mill exists but we can assume it was the same type of mill that was built in other places in the county. It probably had a large wooden wheel that was turned by water power produced by the mill brook with a flume that directed the force of the water on to the wheel. Charles Rhodes had another mill in the area, a saw mill near Middleville on Trout Brook adjacent to the present day Stillwater Municipal building. Mr. Rhodes became Sussex County Clerk in 1783 and held that position until 1799 when he died. The mill was called The Rhodes Mill. Evidently, by the 1830's the mill fell into disrepair or it may even have been abandoned. The Keen family decided to build a more substantial mill some time in the late 1830's. This mill would be of hand-cut limestone and fieldstone. It is believed that the roof, as it is today, is original with the exception of the slate which may have been replaced over the years. The slate on the roof probably came from the slate mine outside of Newton on Ridge Road. The limestone was probably cut from nearby exposed limestone outcrops. The foundation of the mill is mostly set on bedrock that borders the mill brook.

The beams in the mill are mostly oak, cut from nearby properties. The window sashes are of ash also obtained from local sources. The original glass windows were in the mill until about 1965 when vandals smashed them; the owner of record, at that time, replaced them. Blair Academy assumed ownership some time in the late 1800's.

The dam, as it stands today, was built about 1905 or 1906; the previous dam was washed out in a spring freshet. The dam was replaced with a log-crib dam with very large stones to anchor it on the inside. The spillway portion had been open until just before Blair sold the property. They put a cement face on the dam wall to prevent the anchor stones from dislodging from within the log-crib portion as they had a tendency to do. On the corner of the mill facing the road to Swartswood is the date 1838, probably cut by the builder. There are other dates cut in the stones around the base of the mill believed to be "doodles" or passersby through the years.

The machinery in the mill has been removed. It is understood that the machinery was installed in the mill about 1895. There was a turbine located in the basement of the mill and had a large iron or steel shaft that went up into the mill proper that worked the grinding stones and the various other implements. At the time of installation, the shaft was bent and when the water was let in through the penstock tube that rotated the turbine it caused a great vibration all over the mill and threatened the destruction of the stones themselves. It is believed that the mill was sold to Blair Academy about that time. Blair was interested in the water of Swartswood Lake in order to maintain a sufficient amount of water to run their power station at Paulina. Blair also controlled the outlet of Fairview Lake; both bodies of water emptied into the Paulinskill River above Paulina.

The dam provided one of the best places to set eel fykes in all of Sussex County; people, at times, would fight to put their fyke in the dam or the old penstock tube. Just across the road from the old mill, the miller's house once stood but evidence of it has long since disappeared. It was possibly built on fieldstone. The interior walls of the mill were all plaster and never painted. Across the dam (over the bridge), according to one old resident, stood a one-room log schoolhouse. Part way up the hill on the old road that crosses the mountain there is evidence of old foundations and some plantings of the day or tiger lillies. Plantings of this flower are usually found around old home sites. Information about this school is not in any history book about Sussex County. The road across the dam has been unused for many years now; it was a township road. The township gave up the road and it became private; but still never used. It washed out badly and had deep ruts in it; it was used at a various times but only with a jeep.

But to return to the mill. Directly in front of the mill, there was an old road of sorts. Supposedly, the wagons with grain could drive up to below the pulley located in the center of the peak of the roof. In the upper story of the mill there was a long wooden shaft that was connected by belts to the main drive shaft and the farmers could have their grain brought inside via a rope or perhaps a platform. It has been said that all of the hardware in the mill was handmade by a blacksmith, as probably the nails were. The main beams are all wooden pegged. The years have taken a toll on the mill; dry rot has destroyed some of the largest beams. One corner, the one not anchored in bedrock, has sunk and disturbed one wall of the mill.

The State of New Jersey purchased the mill, dam and pond in 1976 and it is now part of Swartswood State Park.

At the present time, the interior of the mill is closed to the public.

APPENDIX 2

CHECK LIST

VISUAL INSPECTION

SWARTSWOOD LAKE DAM

CHECK LIST
VISUAL INSPECTION
Phase I

NAME DAM Swartswood Lake Dam COUNTY Sussex STATE New Jersey COORDINATORS N.J. DEP

DATE(s) INSPECTION See Below WEATHER Overcast & Cold TEMPERATURE 30° F

POOL ELEVATION AT TIME OF INSPECTION 481.71* M.S.L. TAILWATER AT TIME OF INSPECTION 472.5* M.S.L.

* Elevation reference to N.J. Geodetic Control Survey, Dept. of Conservation
BM Station 202 which exists on the right abutment (El. 484.47)

INSPECTION PERSONNEL:

J. Richards	12/20/78 12/12/78	J. Rizzo	12/12/78	
P. Yu	12/20/78	D.Leary	12/20/78	
C. Campbell	12/12/78			

Peter Yu RECORDER

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Numerous fallen trees & debris across channel approx. 100' and 300' downstream from dam. Occasional fallen tree in between the two locations.	Fallen trees and debris should be removed.
SLOPES	1 Hor. to 1 Vert. on left bank. 3 Hor. to 1 Vert. on right bank. Bottom slopes of left bank appear to be washed and eroded, roots of trees exposed.	Eroded area should be suitably filled.
APPROXIMATE NO. OF HOMES AND POPULATION	No homes immediate downstream. Village of Stillwater, approx. 2½ miles downstream USGS Topo Map. Population est. about 150	

EARTHFILL GRAVITY DAM WITH MASONRY FACING

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEEPAGE ON LEAKAGE	None Observed	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Loose masonry on right and left abutment/ embankment junction, downstream face. Erosion at right structure/abutment junction downstream face. Gullies as large as 1' wide 8" deep run down slope near N.E. corner of mill house.	Voids around masonry should be filled. Eroded area should be suitably filled.
DRAINS	None Observed	
WATER PASSAGES	None Observed	
FOUNDATION	Horizontal Hole 10" x 8" x 30" deep at toe of right side of dam downstream face.	Hole should be filled.

EARTHFILL GRAVITY DAM WITH MASONRY FACING

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	None observed other than cracks described below.	
STRUCTURAL CRACKING	Loose masonry on both ends of dam.	Voids around masonry should be filled.
VERTICAL AND HORIZONTAL ALIGNMENT	Appears satisfactory	
MONOLITH JOINTS	None Observed	
CONSTRUCTION JOINTS	Mortar cracks downstream face.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	42"-dia. outlet pipe metal lining has rusted	The pipe does not appear in service at this time since the intake gate is surrounded by soil.
INTAKE STRUCTURE	Area in front of the intake gate structure filled.	Intake structure should be relocated or inlet channel be provided.
OUTLET STRUCTURE	Minor construction cracks on masonry surface.	
OUTLET CHANNEL	Leaves, wood logs, rusted structural steel obstructions.	Obstructions and debris should be removed.
EMERGENCY GATE	None observed	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARK OR RECOMMENDATIONS
SLOPES	Appear satisfactory. Occasional vertical bulkhead from some home.	
SEDIMENTATION	Considerable amount of sediment (including leaves) deposited adjacent and up to spillway crest.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Weir surface appears satisfactory. Right abutment wall slightly obstructs flow of water.	
APPROACH CHANNEL	Sediment in approach channel estimated to be high.	Investigate amount of sediment, remove if necessary.
DISCHARGE CHANNEL	Appears satisfactory	
BRIDGE AND PIERS	Wood bridge across top of dam appears satisfactory.	

APPENDIX 3

PHOTOGRAPHS

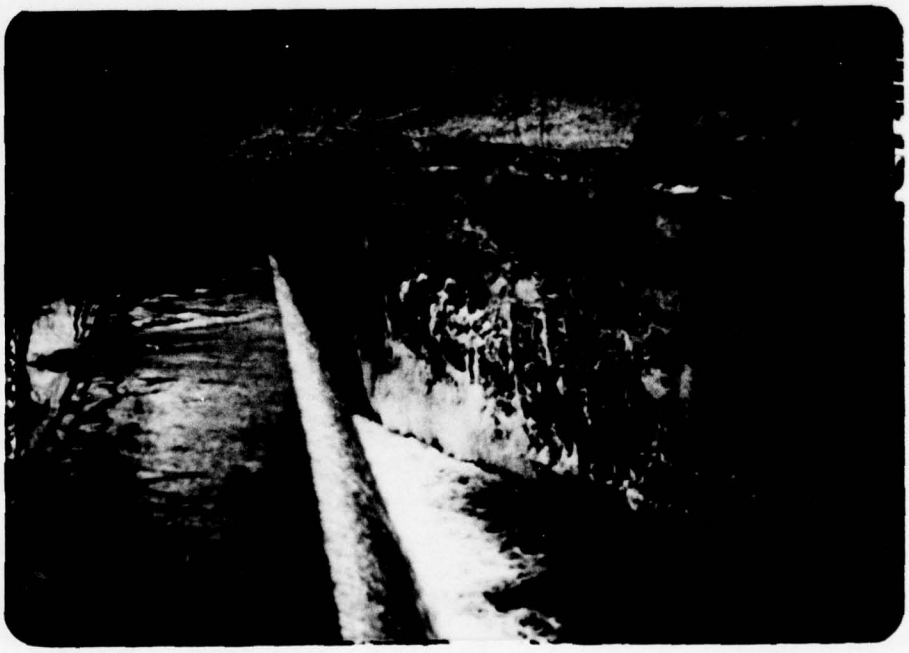
SWARTSWOOD LAKE DAM

Masonry rock face of dam. Looking upstream. 20 December 1978

Abutments and roadway with wooden bridge across dam. Looking west. 20 December 1978

Left side of spillway discharge channel wall and downstream face of dam. Looking east.

20 December 1978



Crest of spillway and discharge channel sidewall upstream of center of dam. Looking east.

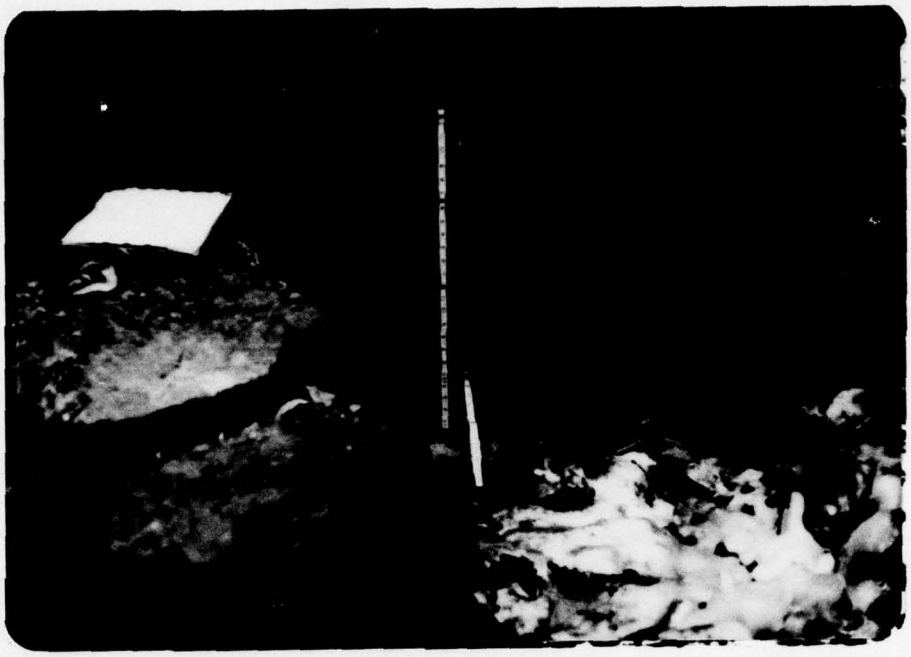
20 December 1978

Survey marker on right concrete abutment. N.J. Geodetic Control Survey, Dept. of Conservation BM Station 202.

20 December 1978

Right abutment and bridge. Note large tree which is uplifting masonry. Looking west.

20 December 1978



Openings at base of dam at right downstream side of abutment. 20 December 1978

Erosion at downstream side of abutment. (Historic Keens Mill House in background). 20 December 1978

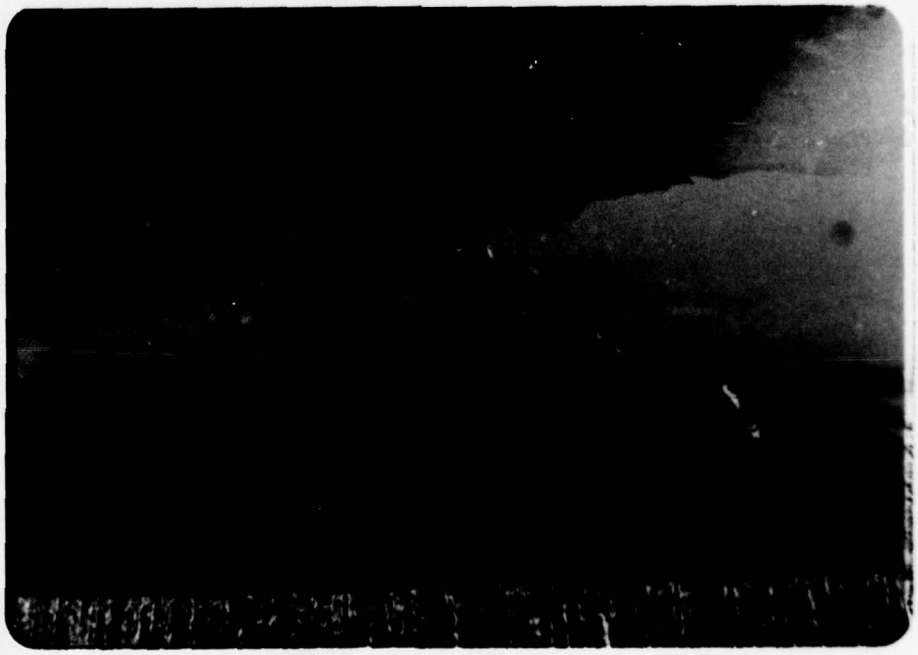
Gated 3.5-ft-dia low level outlet pipe at downstream right face of dam.

20 December 1978

Trash rack and gate stem no longer in use.

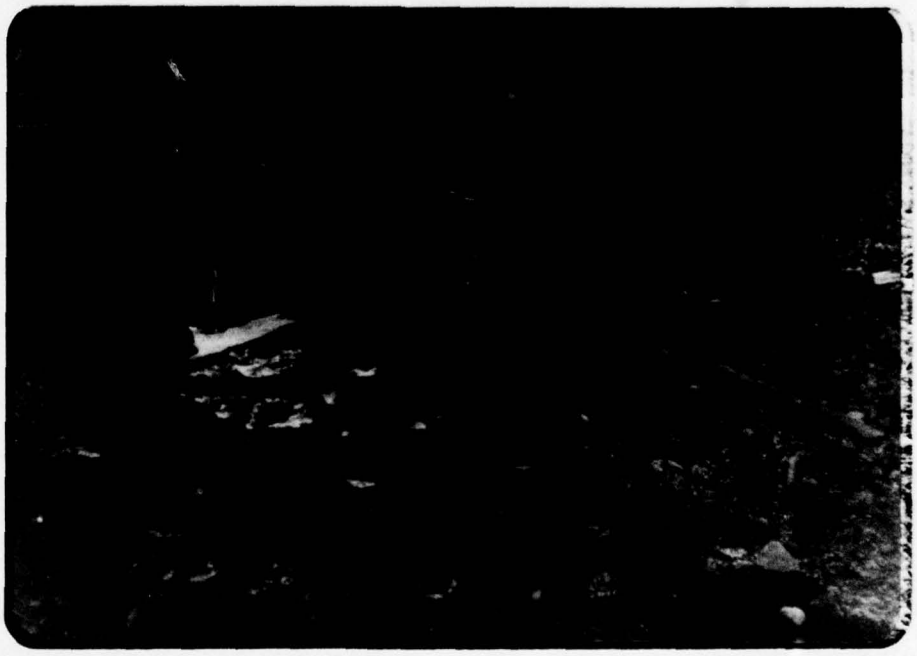
20 December 1978

Deteriorated downstream face of masonry of left abutment. 20 December 1978



Debris upstream of spillway. 20 December 1978

View of lake looking upstream from wooden bridge. 20 December 1978



Downstream discharge channel. 20 December 1978

APPENDIX 4

HYDROLOGIC COMPUTATIONS

SWARTSWOOD LAKE DAM

LANGAN ENGINEERING ASSOCIATES, INC.

HYDROLOGIC COMPUTATIONS
SWARTSWOOD LAKE DAM

Location : Sussex County, N.J.

Drainage Area : 17.2 sq. mi.

Lake Area : 516 Ac.

Classification : size – Intermediate
hazard — significant

Spillway Design Flood :

In accordance with the evaluation criteria, ½ PMF to PMF should be used. The PMF is chosen

COMPUTE PMF

1. Dam located in zone 1 (south boundary)
   PMP = 22 inches
2. PMF must be adjusted for basin size (since dam locates close to zone 6, ∴ take average)

Duration	% Factor (for 17.2 sq. mi) Zone 1	Zone 6	Average	Reduction Factor
0-6	106	108	107	
0-12	118	118	118	0.81
0-24	128	127	128	
0-48	137	138	138	

BY Dy DATE 2-26-79 Swartswood Lake Dam JOB NO. J-783B
CKD GED DATE 4-18-79 SHEET NO. 1 OF 8

Unit Hydrograph

Corp of Engineers has indicated that Snyder Method be used. The following coefficients are recommended:

$C_t = 2.82$, $C_p = 0.62$

Snyder Lag time

$t_p = C_t (L \cdot L_{ca})^{0.3}$

from drainage area

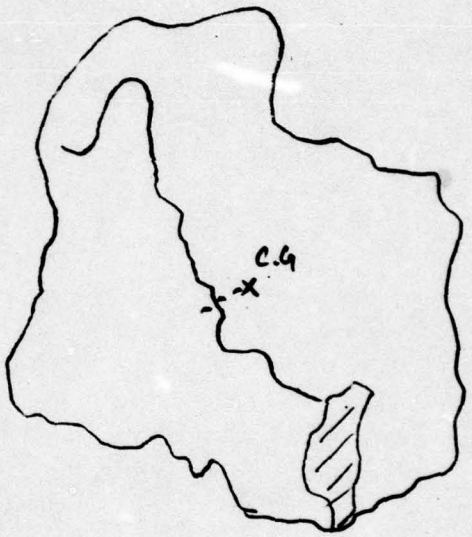
$L \doteq 45700$ ft (8.65 mi)

$L_{ca} \doteq 24200$ ft (4.58 mi)

$\therefore t_p = 2.82 (8.65 \times 4.58)^{0.3}$

$\doteq \underline{8.50 \text{ hrs.}}$

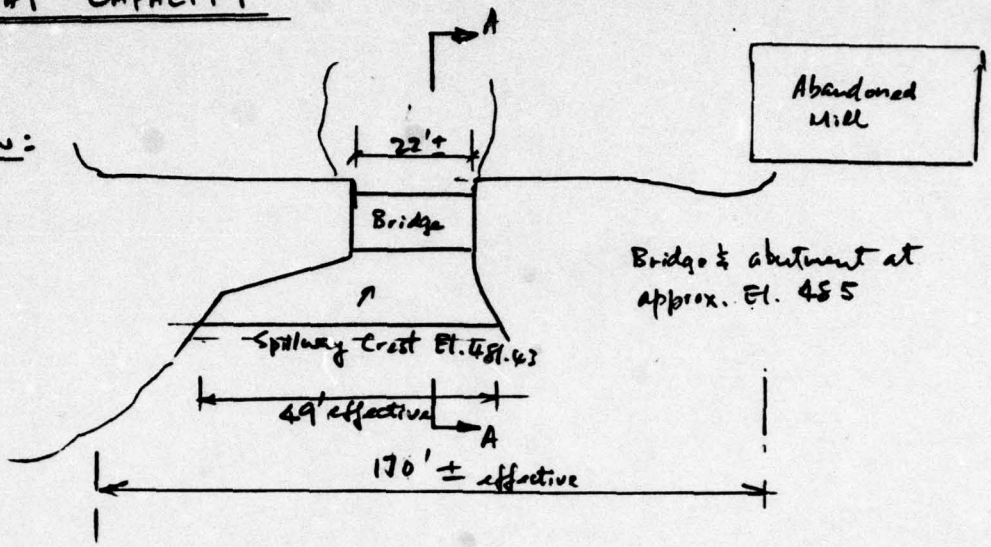
$\underline{C_p = 0.62}$



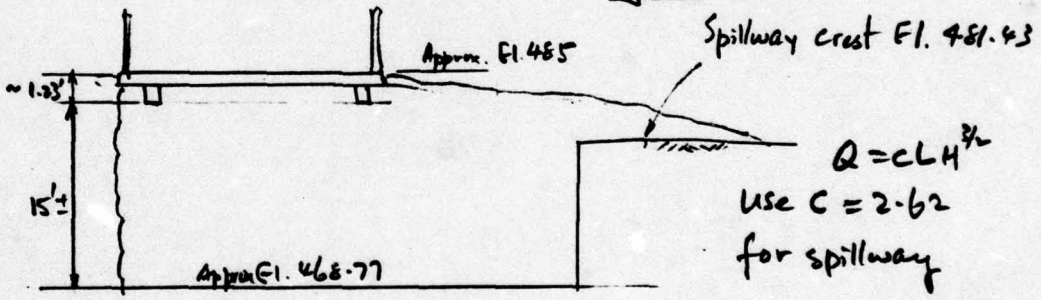
LANGAN ENGINEERING ASSOCIATES, INC.

SPILLWAY CAPACITY

Plan View:



Section A-A:



Outflow first discharges over spillway and flows through culvert under wood bridge. As water level rises to top of abutment (El. 485), $H = 485 - 481.43 = 3.57$ ft

$\therefore Q = CLH^{3/2} = 2.62 \times 49 \times 3.57^{3/2} = 866$ cfs

At this time, tail water under bridge $\doteq 3.85$ ft (from Fig 17-29 of 'Open Channel Hydraulics' by Chow)

∴ culvert not filled yet.

As water level rises, outflow includes discharge over the 49'-spillway and discharge over abutment of 121' (= 170 − 49)

Abutment section similar to spillway section ∴ use C = 2.62

Spillway becomes submerge when tailwater rises to spillway crest. At this time, refering to Chow's book Fig 17.29,

$d = 15$, $H/d = 12.66/15 = 0.84$

$\% = 140$ $\therefore Q = 3080$ cfs

$\therefore$ head on spillway

$$= \left(\frac{Q}{CL}\right)^{2/3} = \frac{3080}{2.62 \times 49} = 8.32 \text{ ft.}$$

$\therefore$ submergence effect is very small.

Assume bridge fails as water rises to top of the deck (El. 485) At this time discharge over spillway continue to flow through bridge culvert section and over top of the abutment sections next to bridge. Assume effect of the obstruction produced by the left embankment to the discharge capacity of the spillway is insignificant, hence the discharge is continued to be governed by the spillway of 49 ft effective length.

Consider an additional outflow section of 50 feet when pool water is above El. 491 (See Fig 2 of report for approximate topography) Use $C = 2.5$

$\therefore$ for spillway

$$Q_S = 2.62 \times 49 \times H^{3/2} = 128.38\, H^{3/2}$$

for abutment section when pool above El 485

$$Q_{A1} = 2.62 \times 121 \times H^{3/2} = 317.02\, H^{3/2}$$

for additional section when pool above El 491

$$Q_{A2} = 2.5 \times 50 \times H^{3/2} = 125\, H^{3/2}$$

LANGAN ENGINEERING ASSOCIATES, INC.

Elevation vs Total Discharge

Elev. (ft)	Spillway H (ft)	Spillway Q_S (cfs)	Abutment section when pool above El 485 H (ft)	Q_{A1} (cfs)	Additional section when pool above El 491 H (ft)	Q_{A2} (cfs)	Total Q_T (cfs) $=Q_S+Q_{A1}+Q_{A2}$
481.43	0						0
482.43	1	128					128
483.43	2	363					363
484.43	3	667					667
485.0	3.57	866	0				866
486.0	4.57	1254	1	317			1571
487.0	5.57	1688	2	897			2585
488.0	6.57	2162	3	1647			3809
489.0	7.57	2674	4	2536			5210
490.0	8.57	3221	5	3544			6765
491.0	9.57	3801	6	4659	0		8460
492.0	10.57	4412	7	5871	1	125	10408
493.0	11.57	5052	8	7173	2	354	12579
494.0	12.57	5721	9	8560	3	650	14931
495.0	13.57	6418	10	10025	4	1000	17443
496.0	14.57	7140	11	11566	5	1398	20104
497.0	15.57	7887	12	13178	6	1837	22902

BY Py DATE 2-27-79 Swartswood Lake Dam JOB NO. J-783 B

CKD GED DATE 4.18.79 SHEET NO. 5 OF 8

LANGAN ENGINEERING ASSOCIATES, INC.

BY RY DATE 2-7-79 Swartswood Lake Dam JOB NO. T-783B

CKD GED DATE 4-18-79 SHEET NO. 6 OF 8

Reservoir Storage Capacity

Assume a linear increase of the lake dimensions with elevation. Start at a zero storage at the crest of the spillway.

Area of Lake = 516 Ac.

Length of equivalent square = 4741 ft.

Take average side slope = 1V : 5H.

∴ for every foot of water above the crest of spillway the length of equivalent square increases by
= 1 × 5 × 2 = 10 ft

Elev. (ft)	H (ft)	Length of equivalent square (ft)	Area of Lake (Acres)
481.43	0	4741	516
483.43	2	4761	520
485.43	4	4781	525
487.43	6	4801	529
489.43	8	4821	534
491.43	10	4841	538
493.43	12	4861	542
495.43	14	4881	547
497.43	16	4901	551

Storage capacity vs. elevation to be calculated by HEC-1

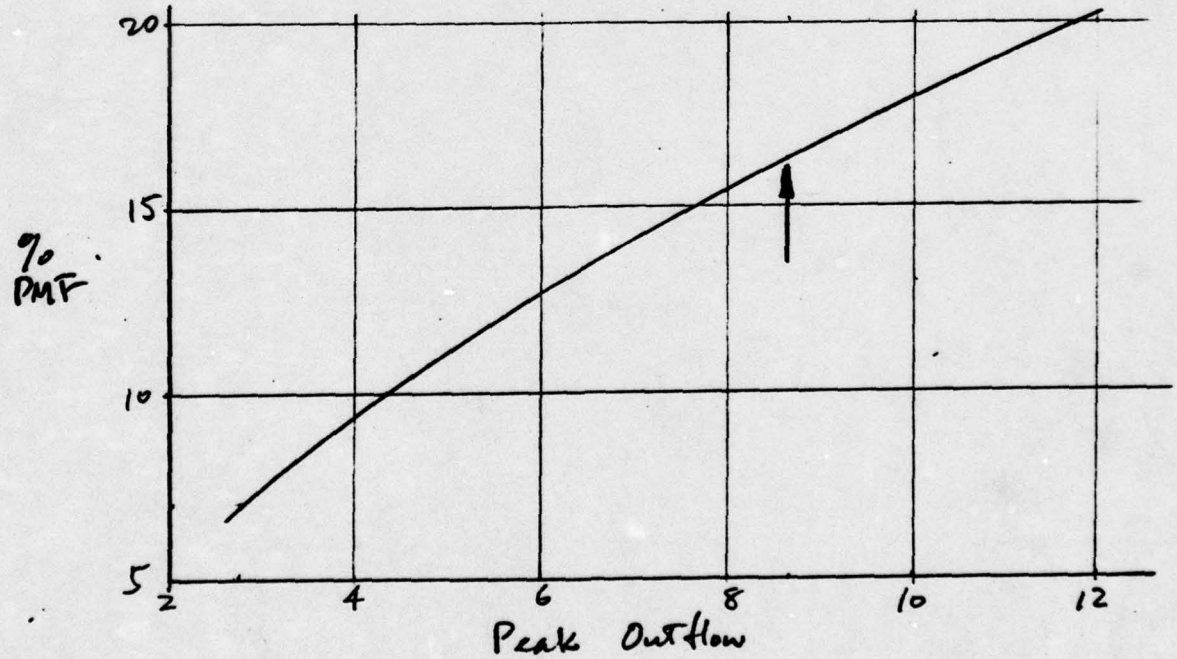
LANGAN ENGINEERING ASSOCIATES, INC.

SUMMARY OF HYDROGRAPH AND FLOOD ROUTING

1. Hydrograph and routing calculated using HEC-1
2. PMF peak inflow for Swartswood Lake is 14,755 cfs (routed to 11,607 cfs)
3. Routing indicates dam will overtop by approximately 7.5 ft. for PMF.

OVERTOPPING POTENTIAL

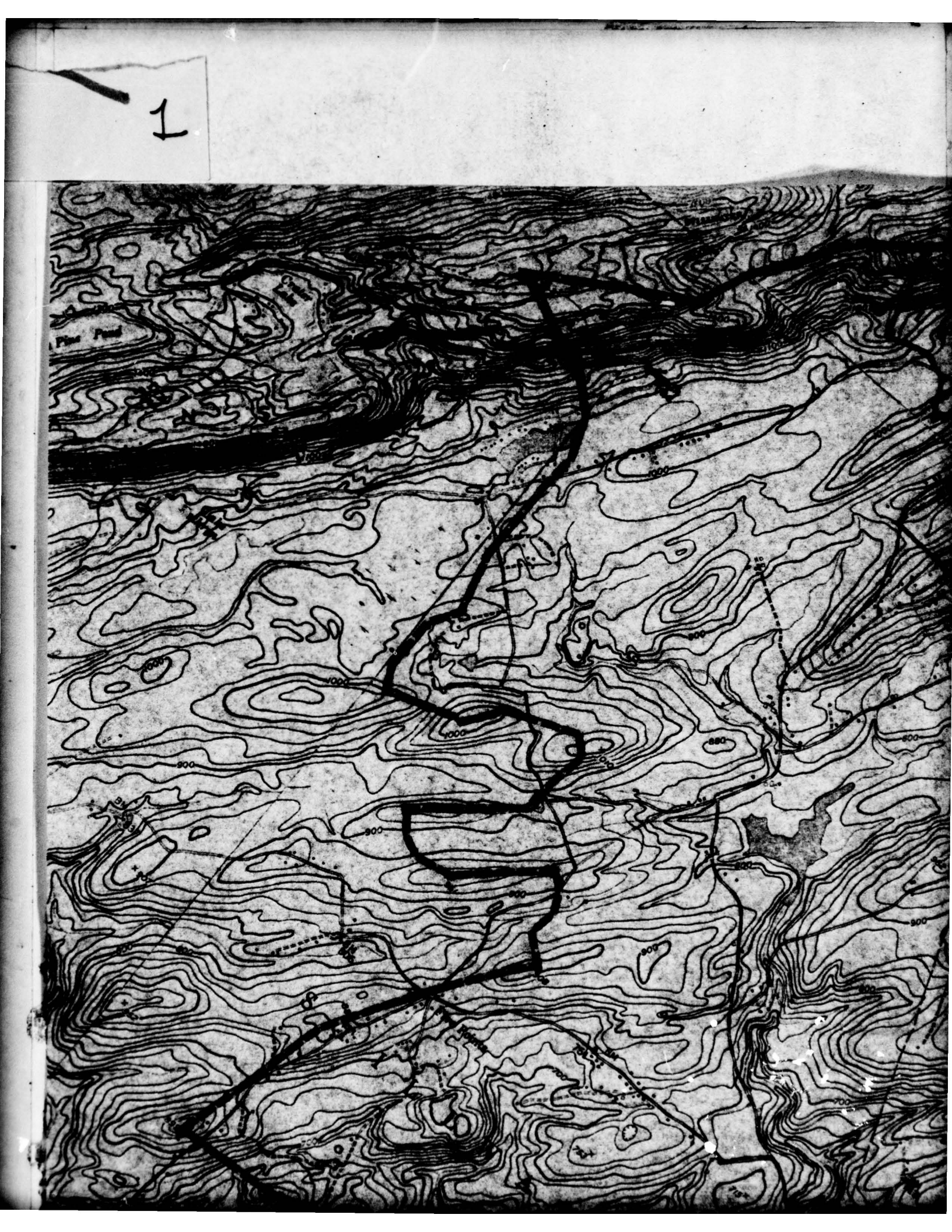
1. Various % of PMF has been routed using HEC-1
2. Plot peak outflow vs % PMF



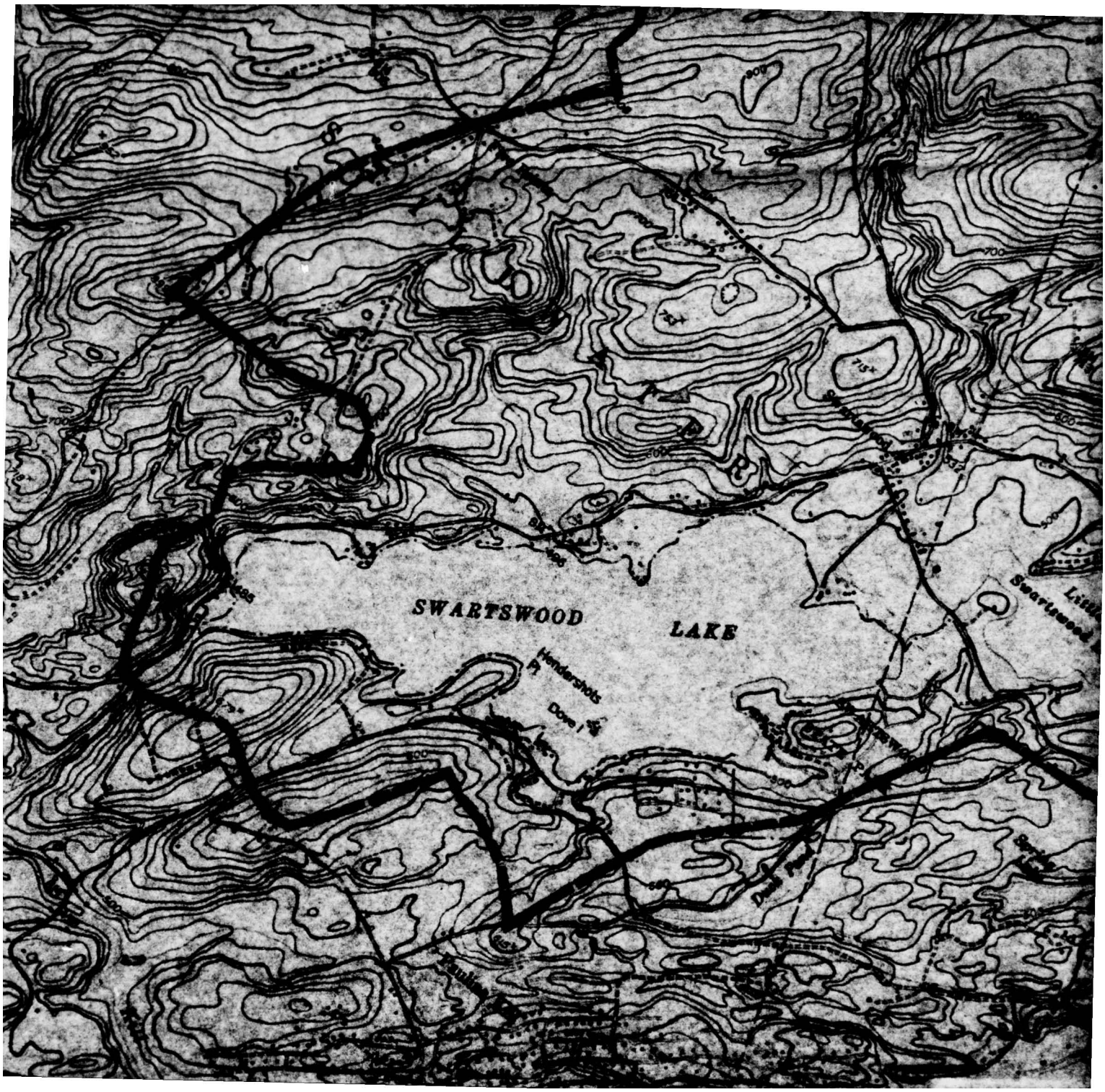
3. Dam overtops at approx. El. 485 with Q = 866 cfs
   ∴ dam can pass approx. 16 % of PMF.

BY [illegible] DATE 2-27-79 Swartswood Lake Dam JOB NO. J-783 B

SHEET NO. 8 OF 8




Bear
H
A
M
P
1000
900
940
800


SWARTSWOOD
LAKE
Hendershots
Dove I
Little
Swartswood


Little
Swartswood Lake
Myrtle
Grove

HEC-1 OUTPUT

SWARTSWOOD LAKE DAM

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****************************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
  LAST MODIFICATION  11 JAN 79
****************************************

A                         SWARTSWOOD LAKE DAM
A                         INFLOW HYDROGRAPH AND ROUTING
A                         N.J. DAM INSPECTION
B      150        1        0        0        0        0        0        0        0        0
B1       3
K                 1
K1   COMPUTE HYDROGRAPH                                  1
M        1        1     17.2
P                22      107      118      128      .81
T                                                   138
W      8.5      .62                                      1      .15
X       -2                 1
K        1        2                                      1
K1   ROUTING COMPUTATIONS
Y                                   1
Y1       1                                                          -1
Y4  481.43   482.43   483.43   484.43    485.0    486.0    487.0    488.0    489.0    490.0
Y4   491.0    492.0    493.0    494.0    495.0    496.0    497.0
Y5       0      128      363      667      866     1571     2585     3809     5210     6765
Y5    8460    10408    12579    14931    17443    20104    22902
$A     516      520      525      529      534      538      542      547      551
$E  481.43   483.43   485.43   487.43   489.43   491.43   493.43   495.43   497.43
$$  481.43
$D   485.0
K       99
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

```
RUNOFF HYDROGRAPH AT          1
ROUTE HYDROGRAPH TO           2
END OF NETWORK
```

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  11 JAN 79
**********

RUN  DATE= 79/03/01.
     TIME= 13.52.03.
```

SWARTSWOOD LAKE DAM
INFLOW HYDROGRAPH AND ROUTING
N.J. DAM INSPECTION

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
150	1	0	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
3	0	0	0

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

COMPUTE HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	17.20	0.00	17.20	.81	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.00	107.00	118.00	128.00	138.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.15	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 8.50 CP= .62 NTA= 0

RECESSION DATA
STRTQ= -2.00 QRCSN= 0.00 RTIOR= 1.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 9.62 AND R= 7.85 INTERVALS

UNIT HYDROGRAPH 47 END-OF-PERIOD ORDINATES, LAG= 8.44 HOURS, CP= .62 VOL= 1.00

31.	117.	235.	370.	513.	648.	749.	811.	832.	798.
717.	631.	536.	489.	431.	379.	334.	294.	259.	228.
200.	176.	155.	137.	120.	106.	93.	82.	72.	64.
56.	49.	43.	38.	34.	30.	26.	23.	20.	18.
16.	14.	12.	11.	9.	8.	7.			

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	1.00	1	.01	0.00	.01	34.	1.04	4.00	76	0.00	0.00	0.00	517.
1.01	2.00	2	.01	0.00	.01	34.	1.04	5.00	77	0.00	0.00	0.00	459.
1.01	3.00	3	.01	0.00	.01	34.	1.04	6.00	78	0.00	0.00	0.00	407.

1.04	1.00	73	1.00	0.00	0.00	741.	1.07	4.00	148	0.00	0.00	0.00		34.
1.04	2.00	74	2.00	0.00	0.00	657.	1.07	5.00	149	0.00	0.00	0.00		34.
1.04	3.00	75	3.00	0.00	0.00	582.	1.07	6.00	150	0.00	0.00	0.00		34.
									SUM	24.59	19.71	4.88	222735.	
										(625.)	(501.)	(124.)	(6307.15)	

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	14755.	13763.	8082.	3056.	222724.
CMS	418.	390.	229.	87.	6307.
INCHES		7.44	17.48	19.84	20.08
MM		189.07	444.08	503.83	509.93
AC-FT		6925.	16030.	18187.	18407.
THOUS CU M		8418.	19773.	22433.	22705.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTING COMPUTATIONS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

GLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	-1

STAGE	481.43	482.43	483.43	484.43	485.00	486.00	487.00	488.00	489.00	490.00
	491.00	492.00	493.00	494.00	495.00	496.00	497.00			
FLOW	0.00	128.00	363.00	667.00	866.00	1571.00	2585.00	3809.00	5210.00	6765.00
	8460.00	10408.00	12579.00	14931.00	17443.00	20104.00	22902.00			
SURFACE AREA=	516.	520.	525.	529.	534.	538.	542.	547.	551.	
CAPACITY=	0.	1036.	2081.	3135.	4198.	5270.	6350.	7439.	8537.	
ELEVATION=	481.	483.	485.	487.	489.	491.	493.	495.	497.	

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CARFA	EXPL
481.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
485.0	0.0	0.0	0.

END-OF-PERIOD HYDROGRAPH ORDINATES

MO.DA	HR.MN	PERIOD	HOURS	INFLOW	OUTFLOW	STORAGE	STAGE
1.01	1.00	1	1.00	34.	1.	3.	481.4
1.01	2.00	2	2.00	34.	1.	6.	481.4
1.01	3.00	3	3.00	34.	2.	8.	481.4
1.01	4.00	4	4.00	34.	3.	11.	481.5
1.01	5.00	5	5.00	34.	3.	14.	481.5
1.01	6.00	6	6.00	34.	4.	16.	481.5
1.01	7.00	7	7.00	34.	5.	19.	481.5
1.01	8.00	8	8.00	34.	5.	21.	481.5
1.01	9.00	9	9.00	34.	6.	23.	481.5
1.01	10.00	10	10.00	34.	6.	26.	481.5
1.01	11.00	11	11.00	34.	7.	28.	481.5

1.07	5.00	148	148.00	34.	105.	425.	482.3
1.07	6.00	150	150.00	34.	104.	419.	482.2

PEAK OUTFLOW IS 11607. AT TIME 51.00 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	11607.	10923.	7081.	2921.	217693.
CMS	329.	309.	201.	83.	6164.
INCHES		5.91	15.32	18.96	19.62
MM		150.05	389.10	481.54	498.41
AC-FT		5416.	14045.	17382.	17991.
THOUS CU M		6681.	17325.	21441.	22192.

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RUNOFF SUMMARY, AVERAGE FLOW IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES(SQUARE KILOMETERS)

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	1	14755.	13763.	8082.	3056.	17.20
		(417.82)	(389.74)	(228.85)	(86.55)	44.55)
ROUTED TO	2	11607.	10923.	7081.	2921.	17.20
		(328.66)	(309.30)	(200.52)	(82.72)	44.55)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	ELEVATION	481.43	481.43	485.00
	STORAGE	0.	0.	1855.
	OUTFLOW	0.	0.	866.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.00	492.55	7.55	5875.	11607.	39.00	51.00	0.00

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FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 11 JAN 79
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FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  11 JAN 79
**********************************
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PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	1
ROUTE HYDROGRAPH TO	2
END OF NETWORK	

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  11 JAN 79
**********

RUN  DATE# 79/03/21.
     TIME# 14.26.54.
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SWARTWOOD LAKE DAM
% PMF
N.J. DAM INSPECTION

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
150	1	0	0	0	0	0	0	4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 6 LRTIO= 1

RTIOS=	1.00	.50	.20	.10	.07	.04

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

COMPUTE HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	17.20	0.00	17.20	.81	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.00	107.00	118.00	128.00	138.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.15	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 8.50 CP= .62 NTA= 0

RECESSION DATA
STRTQ= -2.00 QRCSN= 0.00 RTIOR= 1.00

UNIT HYDROGRAPH 47 END-OF-PERIOD ORDINATES, LAG= 8.44 HOURS, CP= .62 VOL= 1.00

31.	117.	239.	370.	513.	648.	749.	811.	832.	798.
717.	631.	536.	489.	431.	379.	334.	294.	259.	228.
206.	176.	155.	137.	120.	106.	93.	82.	72.	64.
56.	49.	43.	38.	34.	30.	26.	23.	20.	18.
16.	14.	12.	11.	9.	8.	7.			

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
```
```

SUM 24.59 19.71 4.88 222735.
(625.)(501.)(124.)(6307.15)

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTING COMPUTATIONS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

GLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	-1

STAGE	481.43	482.43	483.43	484.43	485.00	486.00	487.00	488.00	489.00	490.00
	491.00	492.00	493.00	494.00	495.00	496.00	497.00			
FLO.	0.00	128.00	363.00	667.00	866.00	1571.00	2585.00	3809.00	5210.00	6765.00
	8460.00	10408.00	12579.00	14931.00	17443.00	20104.00	22902.00			
SURFACE AREA=	516.	520.	525.	529.	534.	538.	542.	547.	551.	
CAPACITY=	0.	1036.	2081.	3135.	4198.	5270.	6350.	7439.	8537.	
ELEVATION=	481.	483.	485.	487.	489.	491.	493.	495.	497.	

CKEL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
481.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
485.0	0.0	0.0	0.

PEAK OUTFLOW IS 11607. AT TIME 51.00 HOURS

PEAK OUTFLOW IS 4790. AT TIME 53.00 HOURS

PEAK OUTFLOW IS 1177. AT TIME 56.00 HOURS

PEAK OUTFLOW IS 435. AT TIME 59.00 HOURS

PEAK OUTFLOW IS 274. AT TIME 60.00 HOURS

PEAK OUTFLOW IS 125. AT TIME 61.00 HOURS

********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00	RATIO 2 .50	RATIO 3 .20	RATIO 4 .10	RATIO 5 .07	RATIO 6 .04
HYDROGRAPH AT	1	17.20 44.55)	1	14755. 417.82)(	7378. 208.91)(	2951. 83.56)(	1476. 41.78)(	1033. 29.25)(	590. 16.71)(
ROUTED TO	2	17.20 44.55)	1	11607. 328.66)(	4796. 135.65)(	1177. 33.34)(	435. 12.32)(	274. 7.77)(	125. 3.54)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	481.43	481.43	485.00
STORAGE	0.	0.	1855.
OUTFLOW	0.	0.	866.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	492.55	7.55	5875.	11607.	39.00	51.00	0.00
.50	488.78	3.78	3809.	4790.	31.00	53.00	0.00
.20	485.44	.44	2087.	1177.	13.00	56.00	0.00
.10	483.67	0.00	1159.	435.	0.00	59.00	0.00
.07	483.05	0.00	840.	274.	0.00	60.00	0.00
.04	482.41	0.00	505.	125.	0.00	61.00	0.00

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FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 11 JAN 79
****

APPENDIX 5

REFERENCES

SWARTSWOOD LAKE DAM

APPENDIX 5

REFERENCES

SWARTSWOOD LAKE DAM

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3. Eby, C.F., 1976 Soil Survey of Morris County, New Jersey, U.S. Department of Agriculture, Soil Conservation Service, 111 pp.

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